Application #____________________ Fees Paid ______________	
Date Received:_____________ Accepted by __________________	
Date deemed complete ____________ App Deny Conditions	

APPLICATION FOR ORDINANCE TEXT AMENDMENT
CITY OF GREENVILLE, SOUTH CAROLINA

APPLICANT INFORMATION

City of Greenville
NAME

206 S Main Street
ADDRESS

Greenville, SC 29601

(864) 467-4476
PHONE

(864) 467-4510
FAX

planning@greenvillesc.gov
EMAIL

SIGNED (City Manager)

DATE

REQUEST

PERTINENT CODE SECTION(S):

Amendment to Article(s) 19-6-9 of the Land Management Ordinance

NARRATIVE DESCRIPTION/PROPOSED REVISION(S):

This text amendment will replace the existing provisions in the Land Management Ordinance for Section 19-6.9. Single-family residential infill standards. Proposed amendments will focus standards within existing single-family residential areas to achieve more balanced growth and maintenance of neighborhood character, integrity, diversity, affordability, and environmental features. This amendment will be applicable to new lots, construction of a new structure, additions of garages/carports, installation/expansion of driveways, and significant renovations and additions within residential zoning districts. Generally, this amendment is comprised of standards for neighborhood character protection, stormwater mitigation, and tree canopy protection.

INSTRUCTIONS

1. THE APPLICATION AND FEE, **MADE PAYABLE TO THE CITY OF GREENVILLE**, MUST BE RECEIVED BY THE PLANNING AND DEVELOPMENT OFFICE NO LATER THAN 5:00 PM OF THE DATE REFLECTED ON THE ATTACHED SCHEDULE.

2. THE APPLICANT MUST RESPOND TO THE "STANDARDS" QUESTIONS ON PAGE 2 OF THIS APPLICATION (YOU MUST ANSWER "WHY" YOU BELIEVE THE APPLICATION MEETS THE TESTS FOR GRANTING A TEXT AMENDMENT). SEE ALSO ***SECTION 19-2.3.2, AMENDMENTS TO TEXT AND ZONING DISTRICT MAP***, FOR ADDITIONAL INFORMATION. YOU MAY ATTACH A SEPARATE SHEET ADDRESSING THESE QUESTIONS.

3. YOU MUST ATTACH THE REQUIRED APPLICATION FEE: $ 100.00.

4. THE ADMINISTRATOR WILL REVIEW THE APPLICATION FOR "SUFFICIENCY" PURSUANT TO ***SECTION 19-2.2.6, DETERMINATION OF SUFFICIENCY***, PRIOR TO PLACING THE APPLICATION ON THE PLANNING COMMISSION AGENDA. IF THE APPLICATION IS DETERMINED TO BE "INSUFFICIENT", THE ADMINISTRATOR WILL CONTACT THE APPLICANT TO REQUEST THAT THE APPLICANT RESOLVE THE DEFICIENCIES. ***YOU ARE ENCOURAGED TO SCHEDULE AN APPLICATION CONFERENCE WITH A PLANNER, WHO WILL REVIEW YOUR APPLICATION FOR "SUFFICIENCY" AT THE TIME IT IS SUBMITTED. CALL (864) 467-4476 TO SCHEDULE AN APPOINTMENT.***

APPLICANT RESPONSE TO *SECTION 19-2.3.2(E)(1), AMENDMENTS TO TEXT*
(YOU MAY ATTACH A SEPARATE SHEET)

1. DESCRIBE THE WAYS IN WHICH THE PROPOSED AMENDMENT IS CONSISTENT WITH THE COMPREHENSIVE PLAN.

The GVL2040 Comprehensive Plan indicates as a primary principle "strengthening and preserving existing neighborhoods, including careful infill development that adds variety and inclusiveness to neighborhood housing". The adoption of this proposed amendment is directly connected to this identified goal. Additionally, this request is strongly connected to the community's core values, engaging in the protection of neighborhoods that reflects a resourceful, inclusive, and courageous effort.

2. DESCRIBE THE WAYS IN WHICH THE PROPOSAL IS CONSISTENT WITH THE PROVISIONS OF THE ORDINANCE AND RELATED CITY REGULATIONS.

The amendment proposes modification to existing standards for single-family residential infill. These changes will result in construction more consistent with the existing fabric of neighborhoods throughout the City. The amendment will further align single-family infill standards with recent amendments to tree protection and replacement standards and goals for stormwater mitigation.

3. DESCRIBE THE CONDITIONS THAT HAVE CHANGED FROM THE CONDITIONS PREVAILING AT THE TIME THAT THE ORIGINAL TEXT WAS ADOPTED.

Greenville has experienced considerable growth in both commercial and residential development throughout the city over the past decade, which has added stress to existing neighborhoods to accommodate more and larger development. Additional protections are needed to ensure neighborhoods retain their character and remain affordable to those that would traditionally reside in those existing residential areas.

4. DESCRIBE THE WAYS IN WHICH THE PROPOSAL ADDRESSES A DEMONSTRATED COMMUNITY NEED.

In many City neighborhoods, residents are being surrounded by homes that are not compatible in mass or form, are being inundated with stormwater issues, and are losing traditional tree canopy characterizing how their community looks and functions. The proposal addresses this demonstrated community need by creating additional protections for existing single-family residential areas ensuring a consistent development pattern and environmental protections moving forward.

5. DESCRIBE THE WAYS IN WHICH THE PROPOSAL IS CONSISTENT WITH THE PURPOSE AND INTENT OF THE ZONING DISTRICTS IN THE ORDINANCE, WILL PROMOTE COMPATIBILITY AMONG USES, AND WILL PROMOTE EFFICIENT AND RESPONSIBLE DEVELOPMENT WITHIN THE CITY.

The proposal is consistent with the purpose and intent of the Ordinance which is to guide development in accordance with the existing and future needs of the city and to promote the public health, safety, morals, convenience, order, appearance, prosperity, and general welfare of the property owners and residents of the city, and other members of the public. The proposal is particularly consistent with Land Management Ordinance "Purpose and Intent" Section 19-1.3.4, *"Promote diverse quality housing, protect neighborhoods"* and Section 19-1.3.10, *"Create harmonious community"*, as the amendment promotes the protection of existing single-family residential areas in residential zoning districts.

6. DESCRIBE THE WAYS IN WHICH THE PROPOSAL PROMOTES A LOGICAL AND ORDERLY DEVELOPMENT PATTERN.

The proposal will ensure a logical and orderly development pattern of the city by protecting the existing character of existing neighborhoods, requiring homes to appear similarly sized, lot sizes to remain consistent within neighborhoods, and retaining relatively equivalent spacing between homes to maintain the rhythm and harmony of structures in existing residential areas.

7. DESCRIBE THE WAYS IN WHICH THE PROPOSED AMENDMENT WILL RESULT IN BENEFICIAL IMPACTS ON THE NATURAL ENVIRONMENT AND ITS ECOLOGY, INCLUDING BUT NOT LIMITED TO: WATER; AIR; NOISE; STORMWATER MANAGEMENT; WILDLIFE; VEGETATION; AND, WETLANDS.

The proposed amendment will positively impact the natural environment through more stringent requirements relating to retention of tree canopy and additional requirements for stormwater mitigation of single-family residential properties not previously regulated.

8. DESCRIBE THE WAYS IN WHICH THE PROPOSED AMENDMENT WILL RESULT IN DEVELOPMENT THAT IS ADEQUATELY SERVED BY PUBLIC FACILITIES AND SERVICES (ROADS, POTABLE WATER, SEWERAGE, SCHOOLS, PARKS, POLICE, FIRE, AND EMERGENCY FACILITIES).

The proposed amendment will ensure a development pattern consistent with existing development in an area, resulting in a very predictable impact on existing public facilities. In many cases, the proposed requirements should ensure minimal new burden is added to existing public facilities and infrastructure.

19-6.9 Single-family residential infill standards

19-6.9.1 General

(A) ***Purpose and intent.*** This section is intended to establish infill development standards that will allow balanced growth and maintain the character, integrity, diversity, affordability, and environmental features of the City's neighborhoods.

(B) ***Applicability.*** The provisions of this section shall apply to all following development activities located in established single-family residential areas:

(1) New lots created by summary plat or major subdivision (*Section 19-2.3.13*).

(2) Construction of any new structure.

(3) Addition of an attached garage/carport.

(4) Installation and/or expansion of a driveway.

(5) Renovations/additions to a dwelling whose construction value exceeds 50 percent of the fair market value of the property as reflected on the Greenville County Tax Assessor's role. All costs of renovations/additions phased over a five-year period shall be combined to determine applicability of the percent threshold criteria.

(6) Additions that increase the principle building footprint square footage by more than 40 percent. All square footage of additions phased over a five-year period shall be combined to determine the applicability of the percent threshold criteria.

(C) ***Definitions.*** For the purposes of this section, the following definitions apply:

Block, in the context of residential infill means the lots and residential buildings fronting both sides of a section of street located between intersecting streets or, in the absence of intersecting streets, the lots and residential buildings fronting both sides of a section of street within 300 feet of each side of the subject property, on which the lot fronts, whichever is greater.

Established single-family residential area, in the context of residential infill, means any property located within a residential zone district.

Form, in the context of residential infill, refers to the shape and scale of a building. Form and its opposite, space, constitute primary elements of architecture and place. Both form and space are given shape and proportion in the design process. Therefore, the placement of a building form in relation to its immediate site and neighboring buildings is a crucial aspect of this form/space relationship.

Form Analysis, in the context of residential infill, means an analysis that combines a number of aspects that must be considered in order to analyze or design a resilient architectural form and resultant placement of that form, including shape, mass, size, proportion, and space.

Height. See *Height of building, Section 19-1.11*.

Mass means the three-dimensional representation of a structure and is the resultant of an analysis of the width, height and overall presentation of an individual existing structure.

Proportion of building means the comparative relation between elements of building size and height.

Shape, in the context of residential infill, refers to the configuration of surfaces and edges of a two- or three-dimensional object. Shape is the contour or silhouette, rather than the detail, of identified structures and is expressed in both plan (2D) and form (3D).

Size, in the context of residential infill, means the spatial dimensions, proportions, magnitude or bulk of a structure or lot configuration.

Space, in the context of residential infill, means the area in, around and between adjacent forms. (With respect to structures within existing neighborhoods, the area and volume between and around existing structures and, with respect to land subdivision, the width and depth of existing lots)

Yard, Rear, in the context of residential infill, means the open space area, at grade, located behind the rear wall of the habitable residential structure on the lot and the rear lot line and extending the full width of the lot.

Yard, Front, in the context of residential infill, means the yard area located in front of the front wall of the habitable residential structure on the lot.

Yard, Side, in the context of residential infill, means the yard area located between the front wall and the rear wall at both sides of the habitable residential structure on the lot.

Yard, Special Side, in the context of residential infill, means the yard area located between the front wall and the rear wall of a habitable residential structure located on a corner lot at the elevation that faces the second street. A special side yard may only occur as a conditioned approval by the Administrator.

19-6.9.2 Neighborhood Character Protection

Character. This section is intended to establish infill development standards that will propagate the existing aggregate of features and traits that compose an existing individual neighborhood, in which an infill project is proposed.

Protection. This section is intended to establish infill development standards that will both protect and maintain the character and integrity of the city's established single-family residential areas.

(A) ***Mass and Form Analysis*.** Prior to submittal for a building permit, the applicant shall perform a mass and form analysis of the immediate area that surrounds the proposed building site. The completed analysis shall be submitted with the building permit application and shall be used to establish the scale, height and placement of a new or replacement structure on the lot.

(1) Mass Analysis. A mass analysis is required to determine the relative appearance of the size and scale of structures in the applicable neighborhood and to ensure that the existing fabric of the neighborhood remains intact as new structures are added and older or damaged structures are replaced.

(a) To conduct the mass analysis, determine the approximate width and height of all the individual residential structure elevations within the same block and then summarize as a representative average.

(b) All new structures or replacements must provide a front elevation design that is within plus or minus 20 percent of the representative average of the width of the existing structure elevations as determined by the mass analysis.

(c) All new structures or replacements must provide a front elevation design that does not exceed the average height of the existing elevations present within the block by more than one story.

(2) Form Analysis. A form analysis is also required to ensure that the existing fabric of the neighborhood remains intact as new structures are added, older or damaged structures are replaced, or new lot subdivisions are proposed. The form analysis is required to preserve and maintain the block *pattern* and *placement* of any new or replacement structure, lot or subdivision.

(a) To conduct the form analysis, determine the shape and proportions of all the residential structure elevations and the spaces between all the residential structure buildings, identified in the mass analysis phase, and then include the finding with the results of the mass analysis.

(b) For subdivision proposals, determine the shape, width and square footage pattern of the existing lots within the study block area and average the result to determine the allowable minimum lot width and size for the neighborhood. Resultant lots shall be within plus or minus 20 percent of the representative average lot width and lot area to ensure sufficient dimensions for a building and spacing between structures consistent with the block pattern, as required in this ordinance.

(3) Exception.

(a) Existing lots, present at the date of adoption of this ordinance, that

i. are significantly narrower than the average width of existing lots within the block; and

ii. which prevent the placement of a new structure that is able to comply within plus or minus 20 percent of the representative average width of the structure elevations by the mass analysis; and

iii. which prevent the ability to comply with the average spacing between existing structures as established by the form analysis

may petition the Administrator to provide a building elevation width that complies with the applicable required side setback of the zoning district, even if the overall elevation is too narrow to comply with the average elevation width of this ordinance.

(b) If a new structure is unable to meet the minimum spacing between structures, as determined by the form analysis step, due to an existing narrow lot width, then the front elevation must:

1. Be designed to not exceed the average existing elevations average height present with the block; and

2. May add one story with a step back no less than 20 feet from the front entry wall elevation. All analysis results shall be reported on the Mass and Form Analysis form, provided by the city, and submitted with an application for a certificate of appropriateness or the building permit application, whichever is applicable.

(B) ***Structure Removal and Replacement.*** Prior to the removal or replacement of any structure in an established residential neighborhood, the applicant must:

(1) Determine if the property is in a neighborhood within a Preservation Overlay District, Historic Overlay District, Historic Resources List or the list of Local Landmarks. If so, *Section 19-2.3.8* will apply.

(2) Must obtain a demolition permit prior to any work.

(C) ***New Structure Placement.*** Prior to the placement of any structure in an established residential neighborhood, the applicant must:

(1) Determine if the property is in a neighborhood within a Preservation Overlay District or Historic Overlay District. If so, *Section 19-2.3.8* will apply.

(2) Must obtain a building permit prior to any work.

(D) ***Structure Support Features.*** To minimize the impact of support features, such as garages, carports, accessory structures and driveways, on the character of established single-family residential areas, this section is intended to establish infill development standards that will address the location of garages or carports and driveways and the orientation of garage or carport openings relative to the street. The following shall apply:

(1) In established single-family residential areas, garages, carports, and driveways shall be constructed in a way that is consistent with the predominant development pattern and rhythm of the block.

(2) Attached garages or carports shall not open onto a front yard, unless:

(a) A majority of the existing dwellings in the block also have attached garages or carports which open onto a front yard; and

(b) The garage or carport adheres to all the following conditions:

1. The garage or carport is integrated into the design of the house.

2. The front wall of the garage or carport must be set back at least 10 feet from the front wall of the house. This setback may include up to 5 feet of the depth of a front porch that spans at least 50 percent of the front façade of the house and is at least five feet in depth.

3. The new garage or carport width shall not exceed 25 percent of the lot width of the building lot.

4. The new garage or carport may be allowed access, via an apron the width of the garage opening, up to a standard two car garage opening.

(3) Attached garages or carports may open onto the special yard of a corner lot. The front door of the house shall not face the special yard. Garages or carports, located in a special side yard that front any road with a speed limit posted above 30mph or any road that is classified as a major residential collector must:

(a) provide a driveway configuration that is a minimum of 24 feet deep from the edge of the road pavement to the face of the garage; and

(b) allow enough space for a vehicle to reorient and enter traffic nose first.

(4) All detached garages/carports shall comply with the provisions of *Section 19-4.4. Accessory uses and structures*.

(5) If a garage or carport is not eligible to open onto a front or special side yard, then driveways and parking shall generally be directed and located to the side and/or rear of the dwelling and shall comply with the following requirements:

(a) The maximum width of a driveway, or the aggregate of multiple driveways or driveway entries into a single lot, shall not exceed 25 percent of the lot width, except in the rear yard.

(b) The lot width used for this calculation is the actual lot width up to a maximum of 80 feet. All lot widths in excess of 80 feet have a maximum driveway width of 20 feet.

(c) All driveway widths may not exceed the calculated allowable width of 20 feet, until the driveway either:

1. Extends into a side yard area in compliance with the same dimensional restrictions of *Section 19-6.9.2(D)(2)(b) 2, 3* and *4*; or

2. Extends into the rear yard area.

(6) Parking pads may be allowed in the front yard provided the pad conforms with all the following:

(a) Parking pads shall not be located within any required zoning district setback; and

(b) Parking pads may be allowed in the area between any required zoning district setback and the front wall of the primary residential structure; and

(c) Parking pad placement must include a minimum of a 5-foot landscape buffer between the edge of the parking pad closest to the residential structure and the front wall or porch of the residential structure.

(7) Circular driveways may be allowed in the front yard provided the driveway conforms with all the following:

(a) The ingress and egress of circular driveways must conform to *Section 19-6.9.2(D)(5)* for driveway width.

(b) Circular driveways shall not be located within any required zoning district setback.

(c) Circular driveways may be allowed in the area between any required zoning district setback and the front wall of the primary residential structure.

(d) Circular driveway placement must include a minimum of a 5-foot landscape buffer between the edge of the drive closest to the residential structure and the front wall or porch of the residential structure.

(8) Parking in a front yard may be allowed by the administrator when conditions exist that do not allow access to the side or rear yard (i.e. topography, limited space between an existing house and the lot line (an area less than 10 feet wide), provided the limiting conditions are not created by the applicant or a lack of foresight by the applicant’s builder or designer of the building placement on the lot.

(9) Backup space in a front yard may be allowed by the administrator when access to an adjacent street may be difficult due to traffic patterns on any road with a speed limit posted above 30mph or any road that is classified as a major residential collector.

19-6.9.3 Stormwater Mitigation

(A) ***Stormwater Retention/ Detention Standards.*** For subdivisions where stormwater quantity requirements of *Article 19-7. Stormwater Management* apply to infill subdivisions, where above ground detention/retention facilities are proposed, they shall:

(1) Be located at least 20 feet from an exterior property line;

(2) Be sloped in a manner that is easily maintained; and

(3) Be designed as an amenity to the development, when deemed feasible by the administrator. Amenity features may include additional landscaping, fountains, trails or other features acceptable to the administrator.

(B) ***Stormwater Standards other than Detention/Retention.*** For single family lots or subdivisions, where the property is not part of a larger common plan and where major or minor stormwater permits are not required or where water quality requirements, as part of a minor stormwater permit are not required, then the following requirements shall apply:

(1) Any increase in the impervious surface shall be mitigated on site using the techniques outlined in the <u>Guidelines for Green Infrastructure & Low Impact Development</u>.

(2) Any removal and replacement of existing impervious surface shall be mitigated on site using the <u>Guidelines for Green Infrastructure & Low Impact Development</u>.

(3) A grading plan that includes details and mitigation techniques as specified above shall be submitted with the application. The grading plan shall conform to the following:

(a) Setback slopes shall not exceed a 4:1 ratio, i.e. no more than a 1 foot change in elevation per 4 horizontal feet.

(b) Runoff collected and concentrated from impervious surfaces shall be discharged within the property boundaries and no closer than 20 feet to the property line, unless discharge is dissipated by a design approved by the Administrator.

(c) On site infiltration mitigation techniques may be up to the property line.

(4) On-site mitigation options not otherwise listed in the <u>Guidelines for Green Infrastructure & Low Impact Development</u> may be used only upon approval of the Administrator.

(5) Where the applicant cannot meet the requirements of on-site mitigation due to adverse site conditions, the Administrator may approve a grading plan that incorporates best management practices for conveyance and dissipation of stormwater runoff off-site.

19-6.9.4 Tree Canopy Protection

(A) ***Tree protection and replacement.*** Protection of existing tree cover, and the incremental growth of the city's tree canopy, is intended to enhance and preserve the environmental and aesthetic qualities of the city; to encourage site design techniques that preserve the natural environment and enhance the developed environment; to control erosion, slippage, and sediment runoff into streams and waterways; to increase slope stability; to improve air quality; to protect wildlife habitat and migration corridors; and to reduce homeowner energy costs.

(1) **Tree Surveys.** Tree surveys are not required for single-family lots or single-family subdivisions. However, the location, species, and size of trees that are proposed to be retained and/or planted to meet these requirements shall be shown on the required site plan. Additionally, trees which are defined as heritage trees per *Section 19-6.3.2(H)* and are slated for removal must be noted on the plans.

(2) **Tree Planting.** Including required street trees, one canopy tree shall be planted for each 2,000 square feet of lot area or portion thereof, minus building footprint. Such trees shall be a minimum 3-inch caliper and may be planted anywhere on the lot. For all existing canopy trees proposed to be retained and measuring at least 6 inches in diameter, their cumulative DBH caliper inches may be counted toward these planting requirements. Retained trees may not be counted toward any optional tree-planting storm water credits per 19-6.9.3.

(3) **Street Trees.** Street trees are required at one shade tree per 40 linear feet of street frontage, or one ornamental tree per 20 linear feet of street frontage. Street tree requirements may count toward the one tree per 2,000 sf requirement of *Section 19-6.9.4(A)(2)*.

   (a) Trees that are retained to meet the requirement of *Section 19-6.9.4(A)(2)* above shall be protected during construction consistent with the provisions of *Section 19-6.3.3*.

(4) **Heritage Trees.** All trees greater than 20 inches in diameter and located within the buffers and setbacks of the lot, or any tree greater than 40 inches in diameter located on the property, are defined as heritage trees per *Section 19-6.3.2(H)* and shall be subject to those same protections or mitigations.

CITY OF GREENVILLE

SINGLE-FAMILY INFILL INSTRUCTIONS AND PATTERN BOOK

Section 1

A. Getting Started

1. City or County GIS Maps may be used to collect data
2. Define and create study area parameters
3. Create list of study properties based on defined subject area

B. Tools and Resources

City of Greenville GIS Interactive Map:

https://citygis.greenvillesc.gov/Html5Viewer/Index.html?viewer=AddressSearch

Greenville County GIS Interactive Map:

https://www.gcgis.org/apps/greenvillejs/

Section 2

A. Mass Analysis

1. Measure lot width for each property within the study area
2. Measure building width for each property within the study area
3. Measure number of building stories for each property within the study area
4. Measure building height for each property within the study area
5. Determine if there are any properties that are considered to be an anomaly and remove from calculations
6. Calculate averages for each item and compare to proposed subject property

B. Example Worksheet

Part B: Mass Analysis

Surrounding Property Address[1]		Lot Width (ft.)	Building Width (ft.)	Building Number of Stories[2,3]	Building Height (ft.)[4]	Property Conditions Anomaly (Yes or No)
Part B.1.A	1 Sample Drive	120 ft	81 ft	2 stories	25 ft	No
	5 Sample Drive	122 ft	73 ft	2 stories	25 ft	No
	7 Sample Drive	131 ft	87 ft	2 stories	25 ft	No
	2 Sample Drive	137 ft	99 ft	2 stories	25 ft	No
	4 Sample Drive	92 FT	55 ft	1 story	15 ft	Yes
	6 Sample Drive	128 ft	83 ft	2 stories	25 ft	No
Part B.1.B	**Surrounding Property Total**	730 ft	478 ft	11 stories	140 ft	
	Surrounding Property Average (AVG)	121.66 ft	79.66 ft	1.83 stories	23.33 ft	
Calculations Minus Anomaly(ies) ***[If applicable, use these calculations in Part B.2.B]***						
Part B.1.C	**Surrounding Property Total**	379 ft	235 ft	10 stories	125 ft	
	Surrounding Property Average (AVG)	126.33 ft	78.33 ft	2 stories	25 ft	

Subject Property Address		Lot Width (ft.)	Building Width (ft.)	Building Number of Stories	Building Height (ft.)
Part B.2.A	3 Sample Drive	138 ft	87ft	2 stories	22 ft
Part B.2.B	**Subject Property Percentage of Surrounding Property Average (AVG)**	+10% Increase of AVG	+13% increase of AVG	0% increase of AVG	-10% decrease of AVG

NOTES:

1. ***See Pattern Book Image: Figure TBD: Infill Study Area***
2. ***See Pattern Book Image: Figure TBD: Building Story and Height Calculations***

Section 3

A. Form Analysis

1. Measure distance from both the right-hand and the left-hand side of each principal structure to the adjacent principal structure for all properties within the subject area
2. Determine if there are any properties that are considered to be an anomaly and remove from calculations
3. Calculate average and compare to proposed subject property

B. Example Worksheet

Part C: Form Analysis

	Surrounding Property Addresses[1] (Between [INSERT Address] and [INSERT Address])	**Space Between Side Building Walls (ft.)**	**Property Conditions Anomaly (Yes or No)**
Part C.1.A	2 Sample Drive and 4 Sample Drive	50 ft	Yes
	4 Sample Drive and 6 Sample Drive	78 ft	
	6 Sample Drive and 8 Sample Drive	75 ft	
	5 Sample Drive and 7 Sample Drive	72 ft	
Part C.1.B	**Surrounding Property Total**	275 ft	
	Surrounding Property Average (AVG)	68.75 ft	
Calculations Minus Anomaly(ies) ***[If applicable]***			
Part C.1.C	**Surrounding Property Total**	225 ft	
	Surrounding Property Average (AVG)	75 ft	

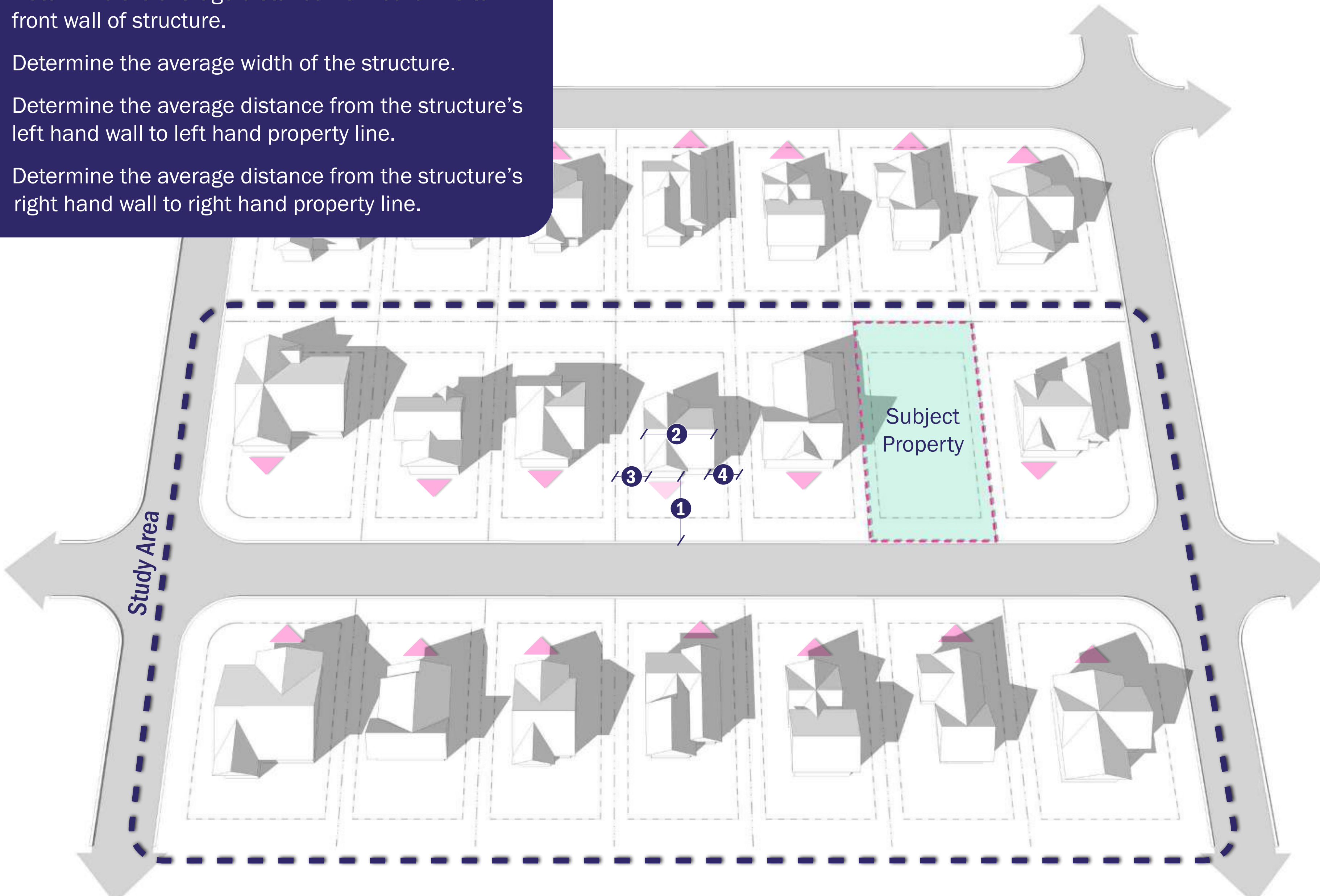
	Subject Property Address	**Space Between Side Building Walls (ft.)**	
Part C.2.A	3 Sample Drive	66	
Part C.2.B	**Subject Property Percentage of Surrounding Property Average (AVG)**	-13% decrease of average	

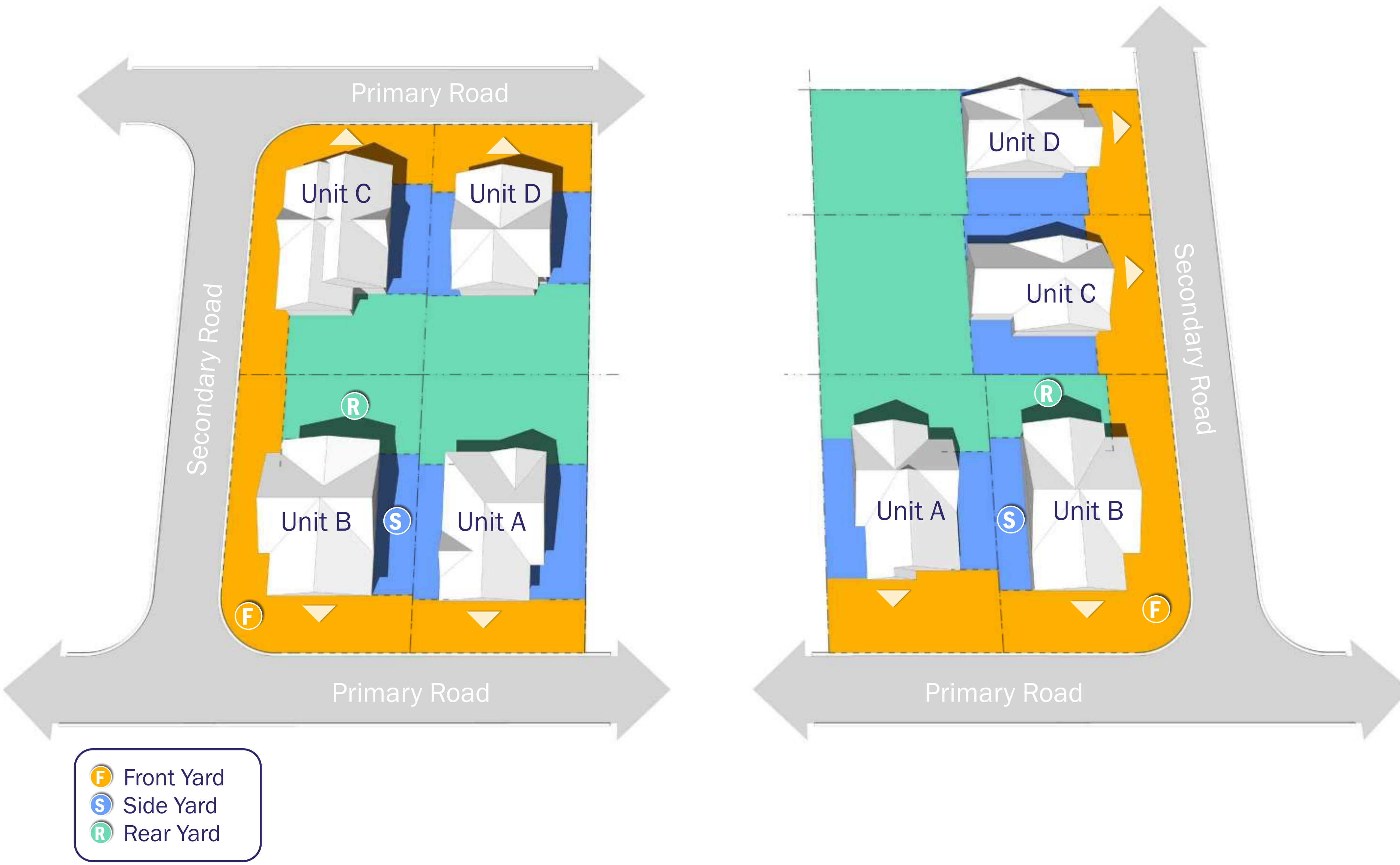
NOTES:

1. ***See Pattern Book Image: Infill Study Area***

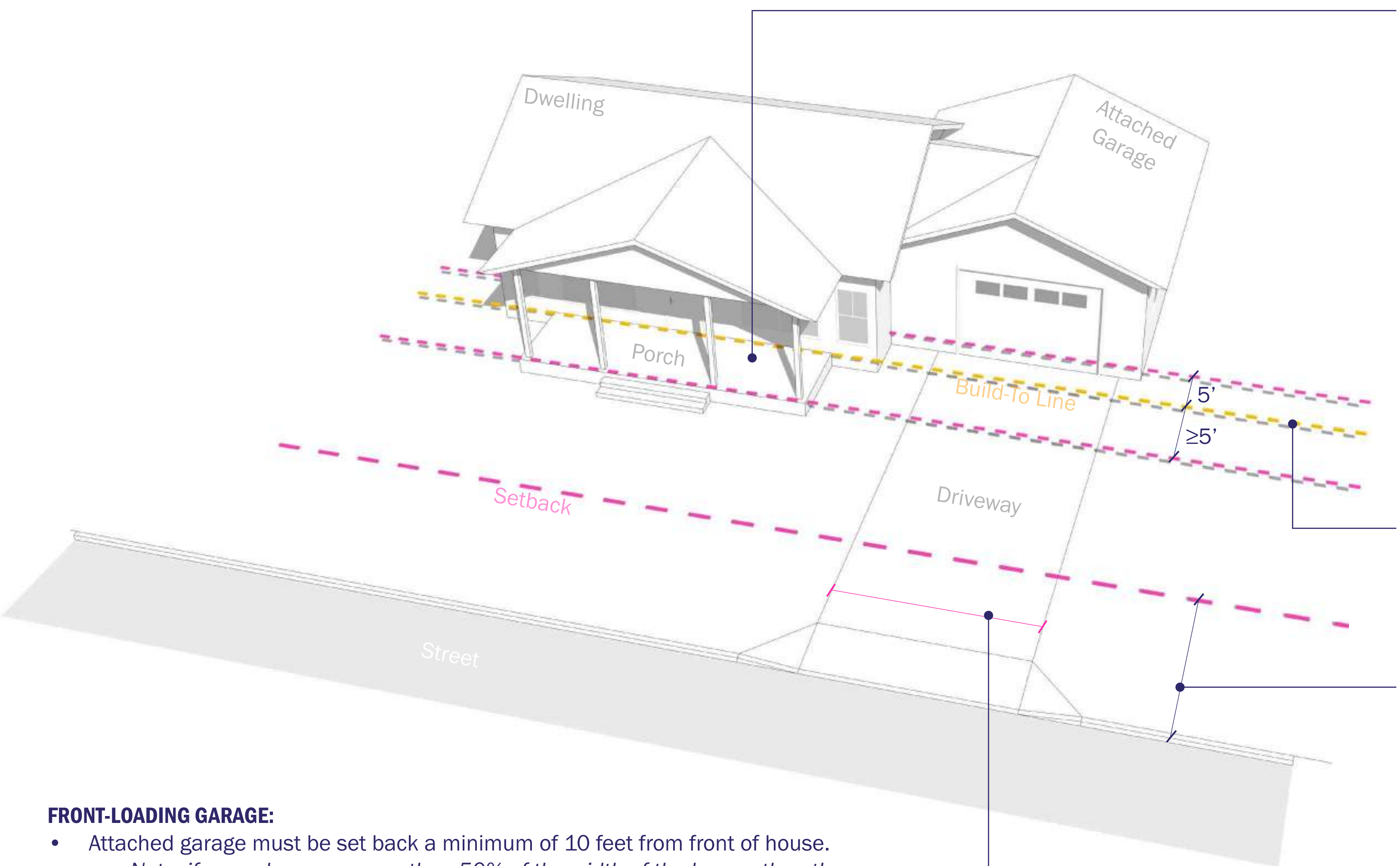
Study Area Form Analysis:

1. Determine the average distance from curb line to front wall of structure.
2. Determine the average width of the structure.
3. Determine the average distance from the structure's left hand wall to left hand property line.
4. Determine the average distance from the structure's right hand wall to right hand property line.



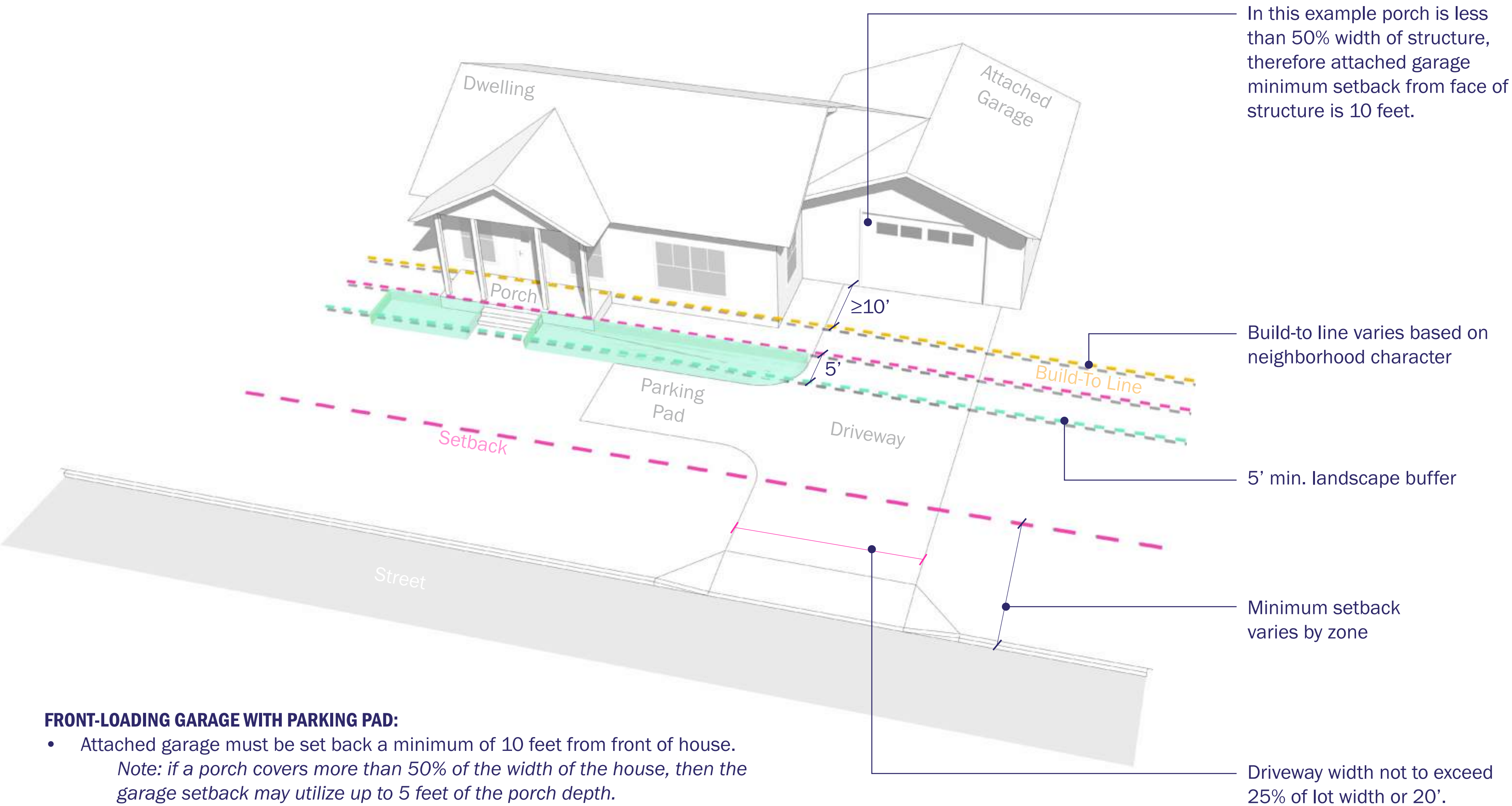


Primary Road
Secondary Road
Unit C
Unit D
Unit B
Unit A
Primary Road
Unit D
Unit C
Secondary Road
Unit A
Unit B
Primary Road
Front Yard
Side Yard
Rear Yard



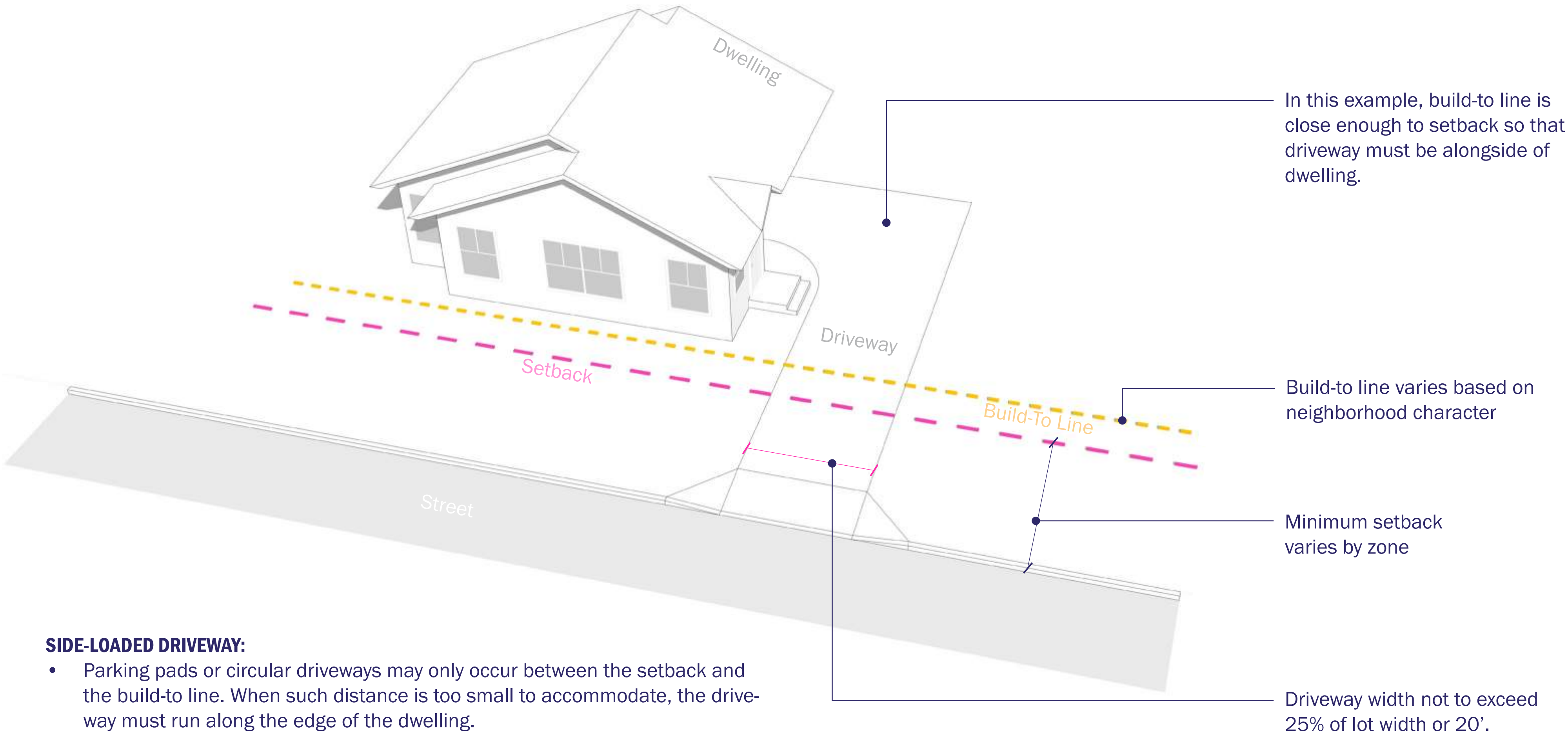
FRONT-LOADING GARAGE:

- Attached garage must be set back a minimum of 10 feet from front of house.
  Note: if a porch covers more than 50% of the width of the house, then the garage setback may utilize up to 5 feet of the porch depth.
- The maximum width of a driveway or aggregate of all driveways may not exceed 25% of the lot width (max. 20 feet).



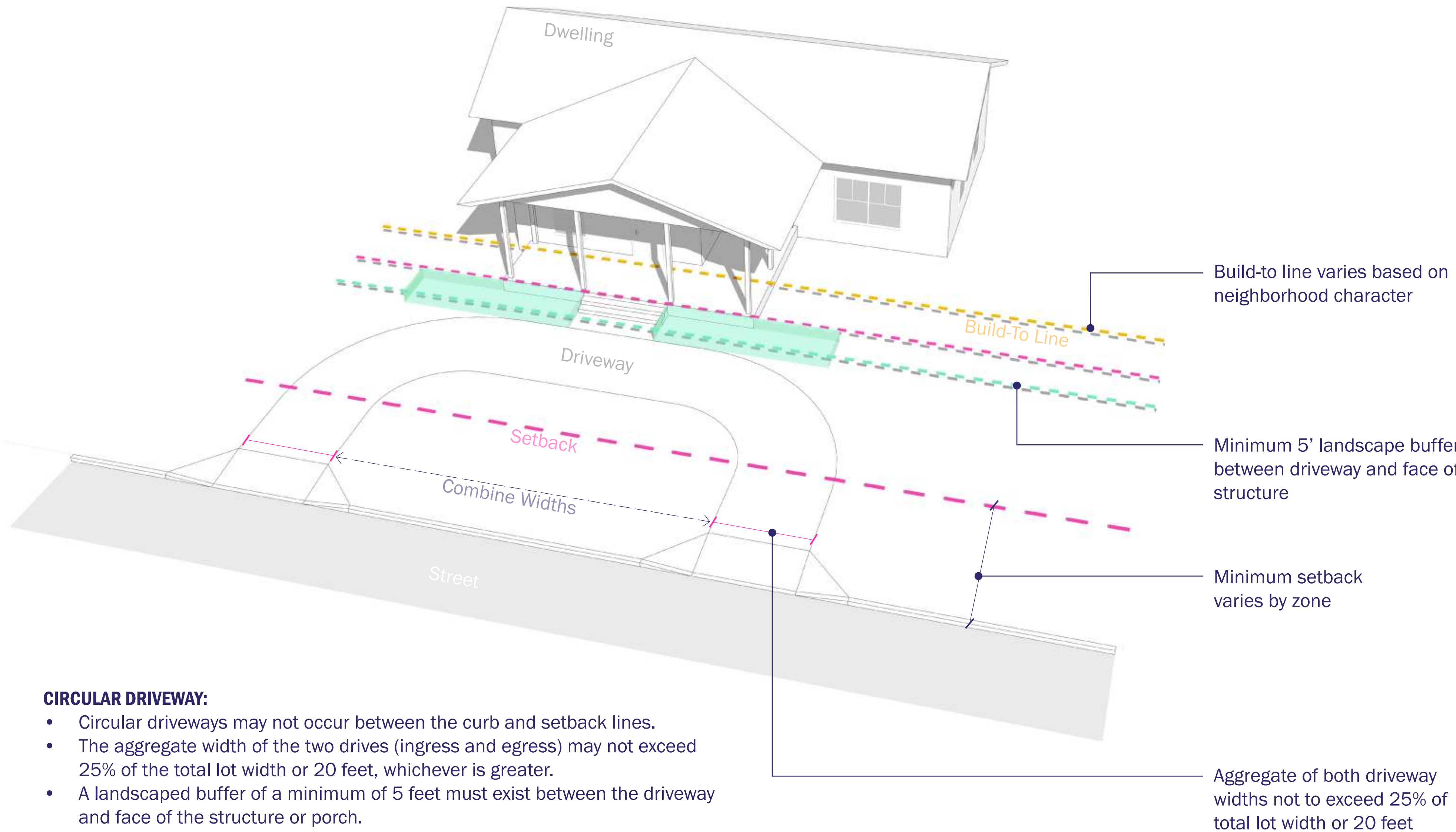
FRONT-LOADING GARAGE WITH PARKING PAD:

- Attached garage must be set back a minimum of 10 feet from front of house.
  Note: if a porch covers more than 50% of the width of the house, then the garage setback may utilize up to 5 feet of the porch depth.
- The maximum width of a driveway or aggregate of all driveways may not exceed 25% of the lot width (max. 20 feet).
- Parking pads are allowed only between the required setback and the front of the house, and must be separated from the house or porch by a minimum 5 foot landscape buffer.



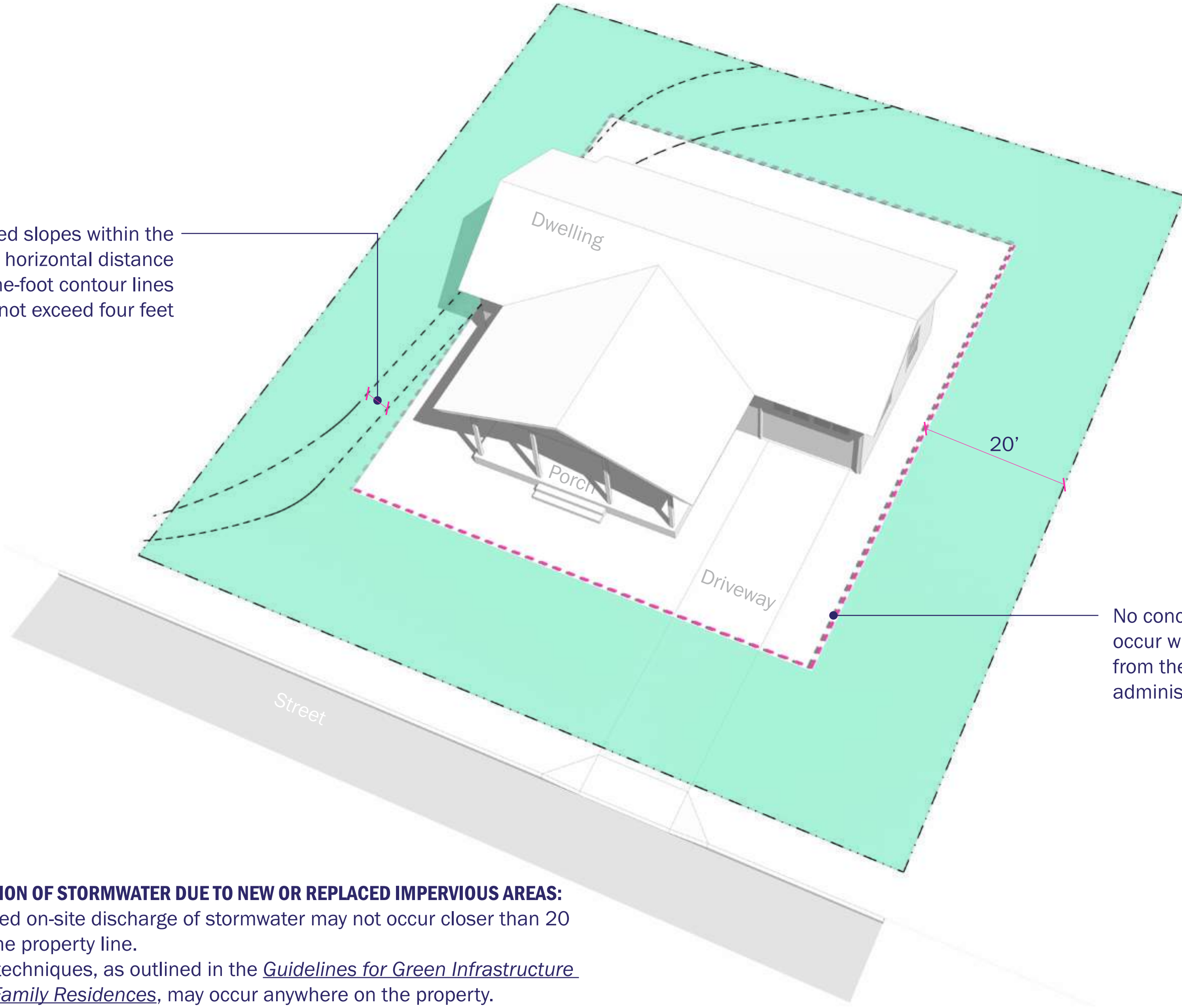
SIDE-LOADED DRIVEWAY:

- Parking pads or circular driveways may only occur between the setback and the build-to line. When such distance is too small to accommodate, the driveway must run along the edge of the dwelling.
- The maximum width of a driveway or aggregate of all driveways may not exceed 25% of the lot width (max. 20 feet).



CIRCULAR DRIVEWAY:

- Circular driveways may not occur between the curb and setback lines.
- The aggregate width of the two drives (ingress and egress) may not exceed 25% of the total lot width or 20 feet, whichever is greater.
- A landscaped buffer of a minimum of 5 feet must exist between the driveway and face of the structure or porch.



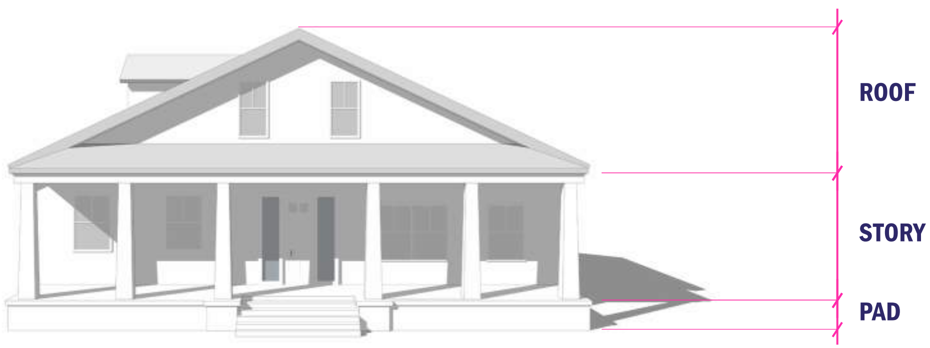
ON-SITE MITIGATION OF STORMWATER DUE TO NEW OR REPLACED IMPERVIOUS AREAS:

- Concentrated on-site discharge of stormwater may not occur closer than 20 feet from the property line.
- Mitigation techniques, as outlined in the *Guidelines for Green Infrastructure for Single Family Residences*, may occur anywhere on the property.
- Setback slopes shall not exceed a 4:1 run to rise ratio.

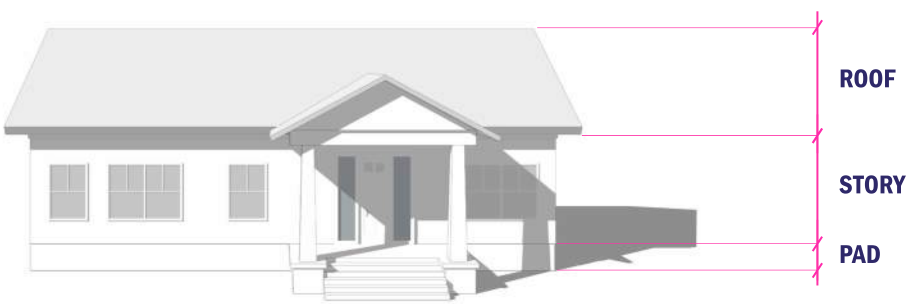
DETERMINING BUILDING STORY AND ELEVATION:
Total building height, regardless of how many stories, is calculated using the formula: **PAD + ALL STORIES + 1/2 ROOF**

1. **PAD** is the base upon which the building sits, measured from average front finish grade to first floor.
2. **STORY** is the occupiable space between floor and ceiling. For an 8' interior ceiling height assume a 9' STORY height; for a 9' interior ceiling height assume a 10' STORY height; etc.
3. **ROOF** is the distance measured from soffit to ridge.

Two Story



One & One Half Story
(when roof area is occupiable)



One Story

2021

city of greenville

Guidelines for Green Infrastructure & Low Impact Development

INTRODUCTION

Background and Purpose

Land development permanently alters the way in which stormwater flows across a site due to grading, compaction, and the installation of impervious cover. Water quantity control is intended to reduce the impacts of development on surrounding properties by storing runoff on site, encouraging infiltration, and preventing erosive concentrated flows. At a state level, water quantity control is mandated by South Carolina Regulation 72-300, which includes provisions for local governments to provide modified or alternative design criteria in response to specific watershed needs.

The purpose of the City of Greenville Guidelines for Green Infrastructure and Low Impact Development is to provide guidance for selecting and installing the appropriate stormwater management measures primarily on smaller sites under 1 acre in size. These guidelines employ simplified design standards that are more applicable to the small site development experience, thus avoiding the need for complex engineering calculations and analysis. These guidelines are meant to complement the use of the City of Greenville Design and Specifications Manual.

Submittal Information

All projects that are not single-family building projects require a site plan application process prior to building permit submittal. For single-family building projects, a site plan will be reviewed alongside the building permit application. The plans for LID projects will be reviewed during either the respective site plan application or building permit application submittal.

The LID practices within these Guidelines should be designed and installed based on the recommendations provided in the section for each practice, or as approved by the City Engineering Department. The City Engineering Department reserves the right to modify these practices or approve other practices at their discretion.

Pictures should be taken of each individual LID practice during installation, before underground features (e.g., perforated underdrain, Dry Well tank, level spreader trench, required excavation depth for stone subbase, amended soil, or filter media) are covered up. Additional pictures should be taken after installation is complete. All pictures should include site-specific landmarks such as unique signs, buildings, or backgrounds, and be provided to the City for verification of installation.

Typically, a Maintenance Agreement is recorded to document the LID installation and maintenance responsibilities and is required as a part of the site plan permitting process.

Frequently Asked Questions

The following section provides, in a question and answer format, information to aid in understanding of these Guidelines and when and how they apply.

What types of projects may utilize the City of Greenville Guidelines for Green Infrastructure and Low Impact Development?

In general, the intent is for the Guidelines for Green Infrastructure and Low Impact Development to be used for projects under 1 acre in size that need to provide water quantity control. This may include:

- Individual residential lots not part of a larger common plan
- Commercial lots that are adjacent to an existing single-family detached use
- Other scenarios at the discretion of the City of Greenville

For ease of discussion, projects utilizing these guidelines for Low Impact Development (LID) practices will be referred to as LID projects below.

What portions of LID projects require Stormwater Management?

These requirements are intended to capture the **major** portions of impervious areas, described below.

Impervious cover is defined as *a surface composed of any material that significantly impedes or prevents the natural percolation of water into soil, which includes, but is not limited to, rooftops, buildings, streets and roads, and any gravel, concrete or asphalt surface.*

The area draining to each practice is called the "contributing drainage area" and normally consists of 100% impervious area for these LID practices, though incidental small pervious areas can be included if unavoidable, and the areas are stabilized to eliminate soil erosion.

What are the principles for managing stormwater on LID projects?

LID projects are not required to provide the same types of stormwater management as major subdivisions or commercial projects; however, certain requirements must be met to ensure that stormwater runoff does not overwhelm stormwater infrastructure or impact adjacent property. The key principles for managing stormwater from LID projects are:

- Green Infrastructure (GI) (see section below);
- Reliance on infiltration only where the water table or bedrock layer is at least two feet below the bottom of the practice in use; and
- Proper installation and maintenance of downspouts, channels, or any other drainage features for concentrated flow.

Note: Many of the native soils in the City of Greenville do not allow for adequate infiltration, therefore a perforated underdrain is required for practices that rely on infiltration. The perforated underdrain must flow to a stable outlet that daylights (emerges from the ground and is open to the air) or tie into a stormwater conveyance system. Specific underdrain requirements for each SFR practice will be discussed in the appropriate sub-section.

What is Green Infrastructure?

The terms Green Infrastructure (GI) and Low Impact Development (LID) refer to practices that reduce runoff by utilizing stormwater practices that encourage the interception, evapotranspiration, infiltration and/or capture of stormwater runoff. Examples of applicable Green Infrastructure techniques include any appropriate combination of the following techniques:

- Installing a rain garden or bioretention area;
- Replacing traditionally impervious surfaces (driveways, patios, etc.) with pervious paving;
- Routing downspouts to underground dry wells;
- Routing downspouts to modified French drains; or
- Directing sheet flow to undisturbed natural water quality buffers or densely vegetated areas.

The goal of these techniques for use in the City is to reduce the volume of runoff and minimize the impact of a site's stormwater runoff on adjacent sites for small, frequent, storm events. GI and LID practices typically do not provide large amounts of runoff storage to address large storm events.

How are Green Infrastructure techniques sized on LID projects?

In order to minimize the effort required for LID projects, sizing tables and/or guidance are provided for each LID practice based on its drainage area. As an alternative to the LID practices in these guidelines, other GI or LID practices that employ runoff reduction techniques to provide storage for 1-inch of runoff may be used in lieu of these techniques with the assistance of a design professional and proper documentation of design criteria and details.

What is in the rest of this document?

The remainder of the document contains:

- A set of six information/specification sheets, one for each of the LID practices recommended for use. For each measure, the last two pages are a set of specifications that can be filled in and submitted with the permit application.
- Appendix A describing infiltration requirements and testing methods for these LID practices.
- Appendix B describing the filter media mix for use in Rain Gardens (LID-05).

Acknowledgements

The City of Greenville Stormwater Division would like to acknowledge and thank the Greenville County Land Development Division and the City of Atlanta, Georgia Department of Watershed Management for making their Green Infrastructure guidelines available for use and modification in the creation of the City of Greenville Guidelines for Green Infrastructure and Low Impact Development.

Technical Specification for:

LID-01 DRY WELL

1.0 Dry Well

1.1 Description

Dry wells are excavated stone-filled systems designed to intercept and temporarily store stormwater runoff until it infiltrates into the soil or leaves the system through a perforated underdrain that drains to a stable outlet. The stone filled excavation may contain either a seepage tank or a perforated pipe and standpipe in order to facilitate movement of runoff through the stone. The use of the seepage tank option is recommended, as it provides more storage volume and reduces the amount of area and excavation required compared to the perforated standpipe option.

Dry wells utilizing a seepage tank are particularly well suited to receive rooftop runoff entering the tank via an inlet grate or direct downspout connection. When properly sized, installed, and maintained, dry wells may provide reductions in stormwater runoff and pollutant loads.

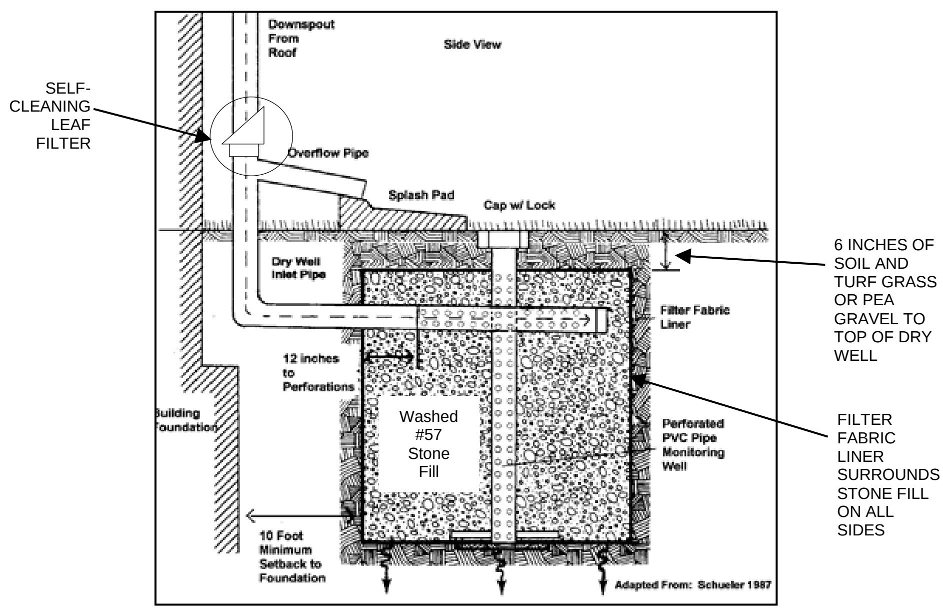
Dry wells are an infiltration-based LID practice which must reliably drain to function as designed. Many of the native soils in the City of Greenville do not allow for adequate infiltration, therefore a perforated underdrain is required. The perforated underdrain must flow to a stable outlet that daylights (emerges from the ground and is open to the air) or tie into a stormwater conveyance system. The City acknowledges that on flat sites, this may be difficult or infeasible due to the depth of Dry Wells**. If installation of an underdrain that daylights is infeasible, infiltration testing must be performed (see Appendix A) to demonstrate an infiltration rate of 0.5 in/hr in order to use a dry well.** If the infiltration rate is inadequate and an underdrain that daylights is infeasible, use other LID practices.

1.2 Using Dry Wells

- Dry wells must be located at least 10 feet from building foundations.
- To reduce the chance of clogging, dry wells should drain only impervious areas and runoff should be pretreated to remove leaves, debris, and other larger particles.
- Ensure the dry well drains through the underdrain and/or infiltration within a drain time of 72 hours or less.
- Dry wells should be located in a lawn or other pervious (unpaved) area and should be designed so that the top of the dry well is located as close to the surface as possible.
- Dry wells should not be located: (1) beneath an impervious (paved) surface; (2) above an area with a water table or bedrock less than two feet below the trench bottom; (3) over other utility lines; or, (4) uphill from or within 20 feet of a septic drain field. Always call 811 to locate utility lines before you dig.

1.3 Construction

- Consider the drainage area size and the soil infiltration rate when determining the size of the dry well. See comments on infiltration rate and underdrains in Section 1.1 above and design guidance on specifications sheet.
- The sides of the excavation should be trimmed of all large roots that will hamper the installation of the permeable drainage fabric used to line the sides and top of the dry well.
- For seepage tank dry wells, the dry well hole should be excavated a minimum of 1 foot deeper and two feet larger in diameter than the seepage tank to allow for a minimum 12-inch stone fill jacket.
- The native soils along the bottom of the dry well should be scarified or tilled to a depth of 3 to 4 inches.
- Install geotextile filter fabric between native soils and the washed #57 stone and dry well tank.
- Fill below and around dry well with a minimum of 12 inches of clean, washed #57 stone. #57 stone diameter averages ½ inch to 1½ inches.
- Fill the final 6 inches of the excavation with native soil. Optionally, pea gravel or #8 stone can be carried to the surface. This top layer should also be separated from the washed stone by geotextile filter fabric.
- For rooftop runoff, install a leaf screen in the gutter or down spout prior to entering the dry well to prevent leaves and other large debris from clogging the dry well. For non-rooftop runoff, precede dry well with an in-ground sump grate inlet leaf trap.
- A stabilized overflow area, such as a vegetated filter strip or grass channel, should be designed to convey the stormwater runoff generated by larger storm events safely bypassing the dry well.
- See specifications sheet for typical seepage tank dry well components and installation.
- See figure below for perforated standpipe dry well constructed of a stone pit and perforated vertical standpipe connected to the inlet pipe. This option also requires a perforated underdrain at the elevation of the bottom of the stone pit (required but not shown below) or infiltration testing if an underdrain is infeasible (see Appendix A).



- If you elect to measure infiltration rate (see Appendix A) and find it is greater than or equal to 1.0 in/hr, the dry well size can be reduced. For every 0.5 in/hr increase in measured infiltration rate above the required 0.5 in/hr, subtract ten percent of the required dry well size, as measured in contributing area captured (square feet) which determines the volume and dimensions of the dry well.

1.3.1 Vegetation

- The landscaped area above the surface of a dry well should be covered with pea gravel when water enters a dry well through surface features rather than the pipe. This pea gravel layer provides sediment removal and additional pretreatment upstream of the dry well and can be easily removed and replaced when it becomes clogged.
- Alternatively, a dry well may be covered with an engineered soil mix and planted with managed turf or other herbaceous vegetation.

1.4 Maintenance

Annual maintenance is important for dry wells, particularly in terms of ensuring that they continue to provide stormwater management benefits over time.

- Inspect gutters and downspouts, removing accumulated leaves and debris.
- Inspect dry well following rainfall events.
- If applicable, inspect pretreatment devices for sediment accumulation. Remove accumulated trash and debris.
- Inspect top layer of filter fabric for sediment accumulation. Remove and replace if clogged.

1.5 Design Example

The fundamental principle of Dry Well design is to provide the required volume based on the drainage area. This requires calculations that will vary based on the size and shape of dry well tanks and the excavation of the stone pit around the tanks. The sub-sections below provide example calculations for a simplified design scenario. Note that Dry Well design is not limited to the tanks and excavation geometries used in this example, as these will vary based on available materials and site-specific constraints.

1.5.1 Calculating Required Volume

A home has a drainage area of 2400 sf that is to be treated for water quality using dry wells following SFR-01 Dry Well guidance. Calculate the required volume for **all dry wells** using the equation from the specification, shown below.

$$Volume\ required\ [cf] = 0.0833 *\ Drainage\ Area\ \ [sf]$$
$$Volume\ required\ [cf] = 0.0833 *\ 2400\ sf$$
$$\boldsymbol{Volume\ required\ [cf] = 200\ cf}\ \textbf{(all dry wells)}$$

The house is rectangular in footprint and the drainage area flows to each corner equally, with 600 sf draining to each corner. A dry well will be installed at each corner, for a total for four dry well installations around the home. Calculate the required volume for **each dry well** using the equation from the specification, shown below.

$$Volume\ required\ [cf] = 0.0833 *\ Drainage\ Area\ \ [sf]$$
$$Volume\ required\ [cf] = 0.0833 *\ 600\ sf$$
$$\boldsymbol{Volume\ required\ [cf] = 50\ cf}\ \textbf{(each of the 4 dry wells)}$$

The volume required for each dry well is 50 cf and the total volume required on the site is 200 cf. Calculations in the sub-sections below are for **one of the four dry wells**, assuming all four will be installed for full site compliance. Note that sites with uneven drainage area distributions may have different required volumes at different treatment locations.

1.5.2 Calculating Provided Volume

The dimensions of the dry well tanks and rock aggregate pit will be assessed by calculating the volume provided by the design and comparing it to the volume required (50 cf per dry well in this example). The volume provided by the design is calculated by adding the storage volume in the tank and the volume capacity of the surrounding rock aggregate, using the equation from the specification, shown below.

$$Volume\ provided\ [cf] = TV\ [cf] + (RV)(P)[cf]$$

TV = Tank volume
RV = Rock aggregate volume
P = Rock aggregate porosity

Tank volume (TV) is calculated from the dimensions of the tank. Rock volume (RV) is calculated from the dimensions of the rock aggregate, adjusted by the rock aggregate porosity (P) since only the volume of the pore space around the rock is available volume to be counted as volume provided.

The following sub-sections elaborate on calculations for TV and RV in two different scenarios, one with a cylindrical rock aggregate pit and another with a rectangular rock aggregate pit.

1.5.2.1 Scenario 1: Cylindrical Tank and Cylindrical Pit Excavation

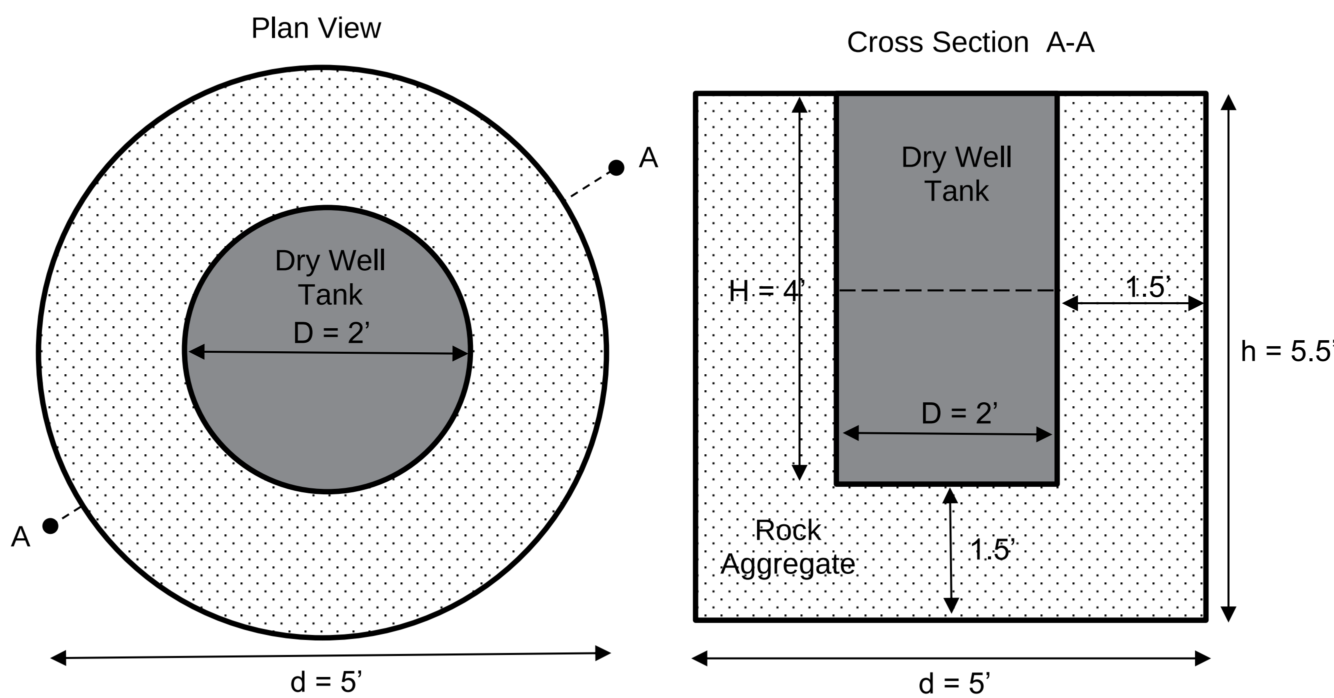
In this example, the design will use stackable, round dry well tanks with a 2 ft diameter (D) and a height (H) of 2 ft. Two dry well tanks (each 2' D x 2' H) will be stacked on top of each other to create a 2' D x 4' H dry well tank. The tank volume is calculated using the formula for the volume of a cylinder, as follows:

$$TV = 3.14 * \left(\frac{D}{2}\right)^2 * H$$

$$TV = 3.14 * \left(\frac{2\,ft}{2}\right)^2 * 4\,ft = 12.5\,cf$$

D = diameter of tank = 2ft
H = tank height = 4ft

The tank described above is installed in a cylindrical pit. The minimum rock thickness around the tank for a dry well installation is 1 ft for both sides and bottom of the tank. In this example, the rock thickness is 1.5 ft for sides and bottom of the tank, to provide adequate volume. The pit has overall dimensions of 5' diameter (d) x 5.5' height (h) from the bottom, as shown in the schematic below.



On the following page, the rock aggregate volume (RV) provided by the design will be calculated to determine if provided volume meets the required minimum volume required to treat the drainage area.

Rock aggregate volume is calculated as the volume of the pit excavated for the dry well minus the volume of the tank, since no rock will be present where the tank is located. The total rock aggregate volume is calculated below.

$$RV = V_{pit} - TV$$

$$RV = \pi * \left(\frac{d}{2}\right)^2 * h - TV$$

d = pit diameter = 5 ft
h = pit height = 5.5 ft
TV = tank volume = 12.5 ft^3

$$RV = \pi * \left(\frac{5ft}{2}\right)^2 * 5.5ft - 12.5ft^3$$

$$RV = 95\ cf$$

The total volume provided by the design can be determined from the previously calculated tank volume and rock aggregate volume. The porosity is determined by the type of rock aggregate used in the design. In this example, 0.4 is used as a typical value of rock aggregate porosity.

$$Volume\ provided\ [cf] = TV\ [cf] + (RV)(P)[cf]$$

$$Volume\ provided\ [cf] = 12.5\ [cf] + (95)(0.4)[cf]$$

$$Volume\ provided\ [cf] = 50.5\ [cf]$$

The volume provided by the dry well installation described above is 50.5 cf, which is greater than the required volume of 50 cf per dry well. The site design of four dry well installations (one dry well installed at each corner of the house receiving equal amounts of stormwater) will provide a total volume of 202 cf, which is greater than required 200 cf volume, so the design meets the drainage area requirements.

The final design is four dry wells, one at each corner of the house, each consisting of a 2’ D x 4’ H dry well tank placed in a cylindrical rock aggregate pit that is 5’ d x 5.5’ h. Volume provided is greater than volume required so the design is acceptable.

1.5.2.2 Scenario 2: Cylindrical Tank and Rectangular Pit Excavation

In this example, the design will use stackable, round dry well tanks with a 2 ft diameter (D) and a height (H) of 2 ft. Two dry well tanks (each 2’ D x 2’ H) will be stacked on top of each other to create a 2’ D x 4’ H dry well tank. This is the same tank used previously in Scenario 1. The tank volume is calculated using the formula for the volume of a cylinder, as follows:

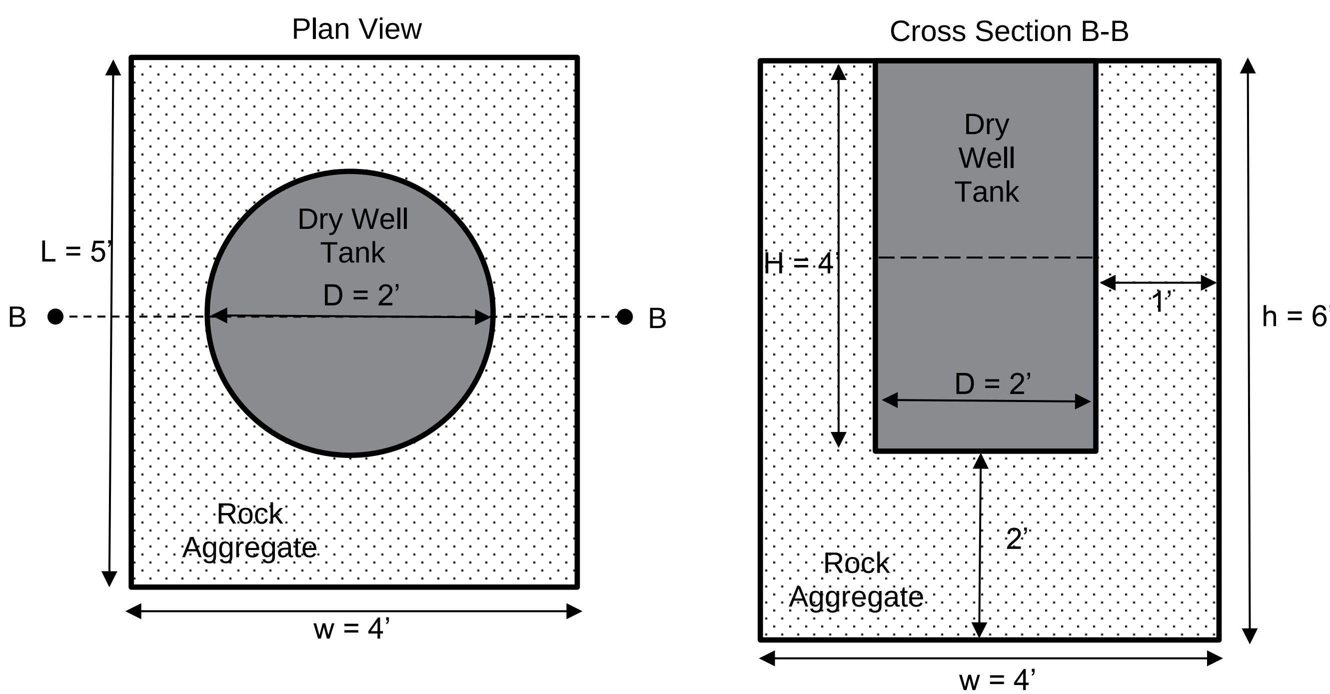
$$TV = 3.14 * \left(\frac{D}{2}\right)^2 * H$$

$$TV = 3.14 * \left(\frac{2\,ft}{2}\right)^2 * 4\,ft = 12.5\,cf$$

D = diameter of tank = 2ft
H = tank height = 4ft

The tank described above is installed in a cylindrical pit. The minimum rock thickness around the tank for a dry well installation is 1 ft for both sides and bottom of the tank. In this example, the rock thickness is 1.5 ft for sides and bottom of the tank, to provide adequate volume. The pit has overall dimensions of 5’ diameter (d) x 5.5’ height (h) from the bottom, as shown in the schematic below.

The tank described above is installed in a rectangular pit. The minimum rock thickness around the tank is 1 ft for both sides and bottom of the tank. In this example, the rock thickness varies between 1 ft and 1.5 ft on sides and is 2 ft on the bottom of the tank, to provide adequate volume. The pit has dimensions of 4’ width (w) x 5’ length (L) x 6’ height (h) from the bottom, as shown in the schematic below.



On the following page, the rock aggregate volume (RV) provided by the design will be calculated to determine if provided volume meets the required minimum volume required to treat the drainage area.

Rock aggregate volume is calculated as the volume of the pit excavated for the dry well minus the volume of the tank, since no rock will be present where the tank is located. The total rock aggregate volume is calculated below.

$$RV = V_{pit} - TV$$

$$RV = w * L * h - TV$$

$$RV = 4ft * 5ft * 6ft - 12.5ft^3$$

$$RV = 107\ cf$$

w = pit width = 4ft
L = pit length = 5ft
h = pit height from bottom = 6ft
TV = tank volume = 12.5 ft^3

The total volume provided by the design can be determined from the previously calculated tank volume and rock aggregate volume. The porosity is determined by the type of rock aggregate used in the design. In this example, 0.4 is used as a typical value of rock aggregate porosity.

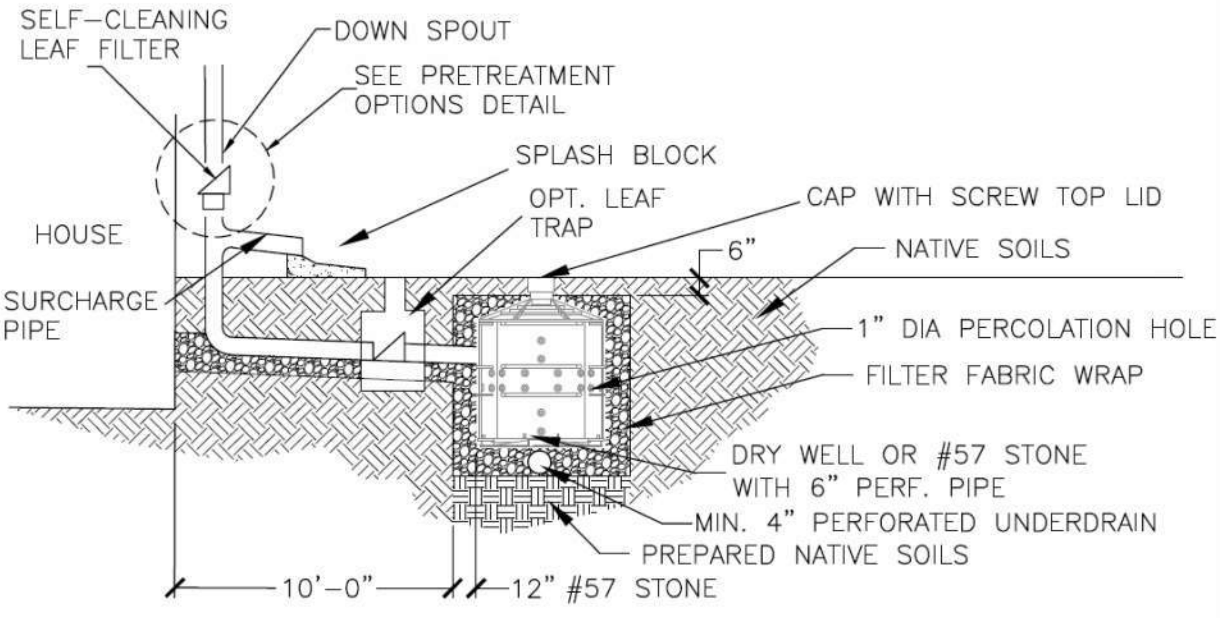
$$Volume\ provided\ [cf] = TV\ [cf] + (RV)(P)[cf]$$

$$Volume\ provided\ [cf] = 12.5\ [cf] + (107)(0.4)[cf]$$

$$Volume\ provided\ [cf] = 55\ cf$$

The volume provided by the dry well installation described above is 55 cf, which is greater than the required volume of 50 cf per dry well. The site design of four dry well installations (one dry well installed at each corner of the house receiving equal amounts of stormwater) will provide a total volume of 220 cf, which is greater than required 200 cf volume, so the design meets the drainage area requirements.

The final design is four dry wells, one at each corner of the house, each consisting of a 2’ D x 4’ H dry well tank placed in a rectangular rock aggregate pit that is 4’ w x 5’ L x 6’ h. Volume provided is greater than volume required so the design is acceptable.

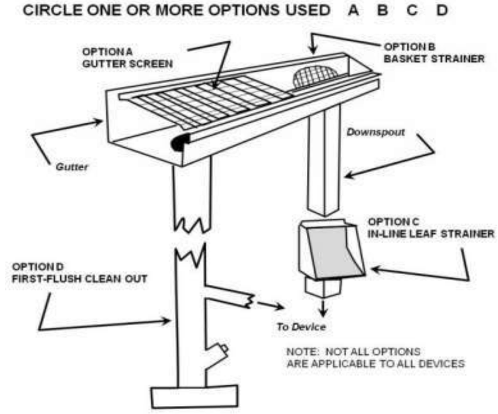


TYPICAL COMPONENTS OF SEEPAGE TANK DRY WELL
(ATTACH MANUFACTURER’S SPECIFICATIONS)

CONSTRUCTION STEPS:

1. Review potential dry well areas and layout. Dry wells should not be located: (1) beneath an impervious (paved) surface; (2) above an area with a water table or bedrock less than two feet below the trench bottom; (3) over other utility lines; (4) uphill from or within 20 feet of a septic drain field; or, (5) within 10 feet of building foundations.
2. Measure the area draining to the dry well and determine required volume on chart on the next page.
3. Design dry well tank and rock volume and demonstrate required volume is provided (attach if necessary).
4. Infiltration rate testing is not necessary when using the required perforated underdrain. If an underdrain is infeasible, see Appendix A for soil infiltration rate testing and requirements.
5. If the infiltration rate is greater than or equal to 1.0 in/hr, the contributing drainage area (square feet) may be decreased 10% for every 0.5 in/hr infiltration rate in excess of the required 0.5 in/hr. See Appendix A for soil infiltration testing and requirements.
6. Measure elevations and dig the hole to the required dimensions. Scarify the bottom soil surface 3” minimum.
7. Place and secure geotextile filter fabric on bottom and down sides of the excavation leaving enough to fold over the top below the soil and turf.
8. Place a minimum of 12” of #57 washed stone in bottom. Pea gravel can be substituted for leveling purposes in the upper three inch layer below the tank.
9. Place tank and install piping. Bond top of tank in place.
10. Cut and route downspouts or other rainwater delivery components including leaf screen option(s) chosen (**circle selected options in Pretreatment Options Detail figure**). Strap and support as needed.
11. Create a safe overflow at least 10 feet from any building foundations and ensure it is protected from erosion.
12. Test connections with water flow.
13. Fill with gravel jacket around tank and ensure filter fabric is installed between gravel and soil.
14. Backfill with soil/sod or pea gravel.
15. Consider aesthetics as appropriate and erosion control for overflow.

CIRCLE ONE OR MORE OPTIONS USED A B C D



PRETREATMENT OPTIONS DETAIL

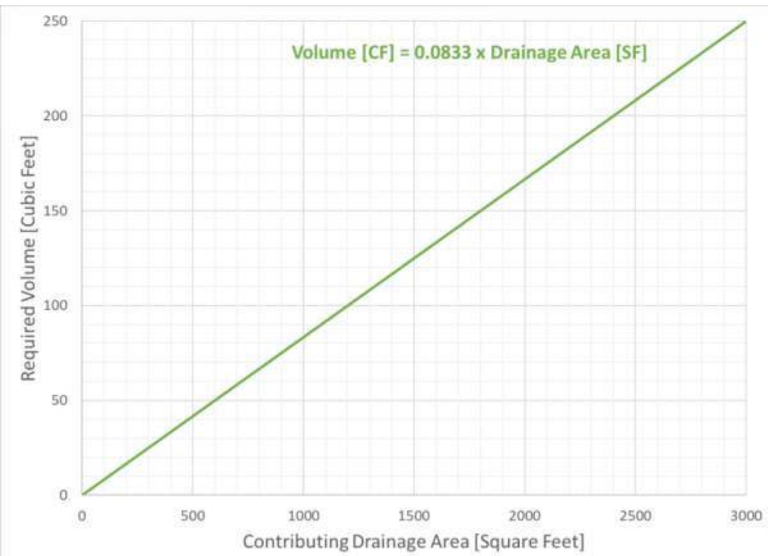
CITY OF GREENVILLE STORMWATER DIVISION	NAME/ADDRESS:	DRY WELL SPECIFICATIONS PAGE 1 OF 2

SKETCH LAYOUT

PROVIDE PLAN AND ELEVATION VIEWS OF DRY WELL AND HOUSE SHOWING ROOF AREA DIRECTED TO DRY WELL AND KEY DIMENSIONS, CONNECTIONS AND OVERFLOW RELATIVE TO PROPERTY LINE. ATTACH ADDITIONAL PAGES IF NECESSARY.

VOLUME REQUIRED:

CONTRIBUTING DRAINAGE AREA= ________ SQ FT



VOLUME REQUIRED =________ CU FT (FROM CHART)

VOLUME PROVIDED:

CALCULATE VOLUME PROVIDED, MUST BE GREATER THAN OR EQUAL TO REQUIRED VOLUME FROM CHART/EQUATION ON LEFT.

DRY WELL TANK VOLUME= (TV)* CU FT
ROCK AGGREGATE VOLUME= (RV) CU FT
ROCK AGGREGATE POROSITY= (P)**
*IF USING STANDPIPE-STONE PIT DRY WELL, TV = 0 (NO TANK PRESENT)
**USE P = 0.4 OR PROVIDE JUSTIFICATION

VOLUME PROVIDED = (TV) + (RV)(P)

= ______ + (_____)(____) CU FT

VOLUME PROVIDED =________ CU FT

IS VOLUME PROVIDED ≥ VOLUME REQUIRED? ________ (YES/NO)

MAINTENANCE:

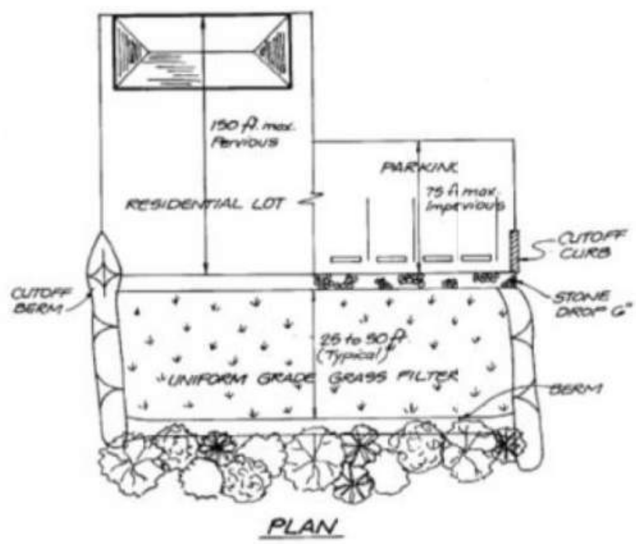
1. INSPECT GUTTERS AND DOWNSPOUTS REMOVING ACCUMULATED LEAVES AND DEBRIS, CLEANING LEAF REMOVAL SYSTEM(S).
2. IF APPLICABLE, INSPECT PRETREATMENT DEVICES FOR SEDIMENT ACCUMULATION. REMOVE ACCUMULATED TRASH AND DEBRIS.
3. INSPECT DRY WELL FOLLOWING A LARGE RAINFALL EVENT TO ENSURE OVERFLOW IS OPERATING AND FLOW IS NOT CAUSING EROSION OR OTHER PROBLEMS.

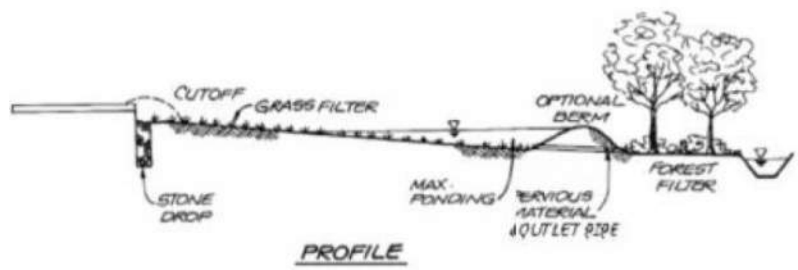
CITY OF GREENVILLE STORMWATER DIVISION	ATTACH THIS TWO-PAGE SPECIFICATION TO HOUSE PLAN SUBMITTAL	DRY WELL SPECIFICATIONS PAGE 2 OF 2

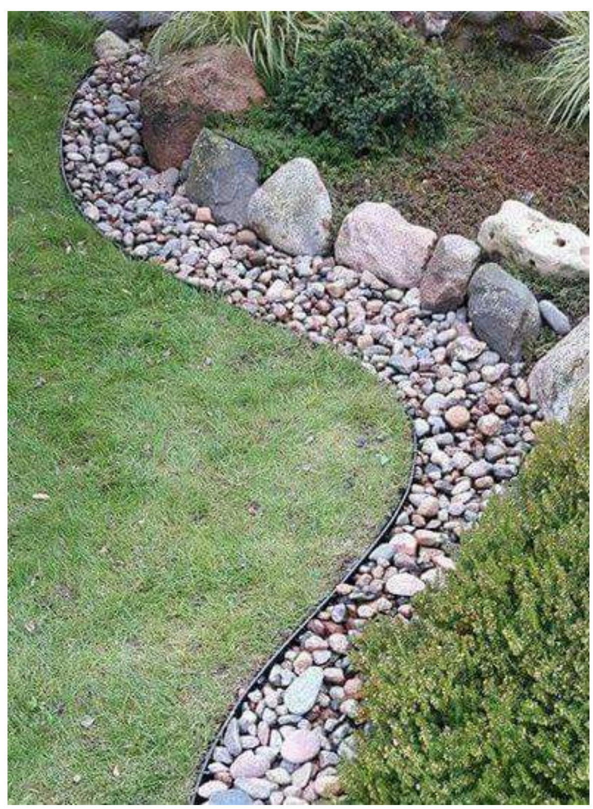
1.0 Vegetated Filter Strip

1.1 Description

A vegetated filter strip can be an attractive and functional addition to your landscape. Vegetated filter strips (also known as grass filters) are uniformly graded, vegetated areas of land designed to receive rainwater as sheet flow and slow and filter stormwater runoff from roof downspouts or parking areas. When properly sized, installed, and maintained, vegetated filter strips may provide reductions in stormwater runoff and pollutant loads. Typical plan and profile schematics are shown below.







1.2 Using Vegetated Filter Strips

- Take note of the drainage patterns to determine the best location for a vegetated filter strip. Assess the drainage area flow paths on your property and the slope of the drainage area. Ideal locations are places where there is a gentle slope away from the structure or paved area, the area is relatively flat, and where the flow can be evenly disbursed along the top of the filter area.
- The ideal slope of the vegetated filter strip is between 1% and 5%. Greater slopes would encourage the formation of concentrated flow within the filter strip, while lesser slopes would encourage unplanned ponding.
- Placing a filter strip over utilities is acceptable except where the amended soil option is used. In that case, ensure utility locations are noted and

care is taken in soil amendment actions. Amended or bermed filter strips should not be placed uphill from or within 20 feet of a septic field.

- The length of the vegetated filter strip should be no less than 25 feet. If there is a permeable berm at the lower end, the length of the vegetated filter strip should be no less than 15 feet. Natural forested areas on site can be counted in the filter strip length total.
- The surface impervious area to any one discharge location cannot exceed 5,000 square feet.

1.3 Construction

- Measure the rooftop and any other area that is going to be directed to the filter strip. See sizing table on the specifications sheet. From the site layout drainage area, select the size and type of filter strip from the table.
- There are three types of filter strips: conventional, amended soil, and berm. The use of amended soil or a berm reduces the required size of the filter strip, as shown in the sizing table.
- For example, a 1,000 square foot rooftop with a conventional filter strip would require at least 2,000 square feet of area with a minimum flow length of 25 feet. The use of amended soil reduces the required area to 670 square feet, still with a minimum flow length of 25 feet. If built with a berm, it can have a surface area of 500 square feet and have a minimum flow length of 15 feet.

1.3.1 Amended Soil Design Option

- Required filter area can be reduced by amending the soil within the filter strip by tilling the existing soil 12” deep and mixing 4” of compost. This increases infiltration within the filter strip.

1.3.2 Berm Design Option

- Filter area can be further reduced through the use of a permeable berm at the bottom end of the filter strip. The permeable berm is used to temporarily store stormwater runoff within the filter strip, which increases the infiltration and reduces the required width of the filter strip.
- Permeable berms should be constructed of well drained soils (sand, gravels, and sandy loams) that support plant growth and should be no more than 12” high.
- Appropriately sized outlets should be provided within permeable berms to ensure that vegetated filter strips will drain within 24 hours following the end of a rainfall event.
- A stone-protected overflow area through the berm may be used to manage the stormwater runoff generated by large storm events. The overflow point must be at least 20 feet from the property line if flow is onto adjoining property. Erosion protection is critical.

1.3.3 Level Spreader

- All vegetated filter strips require a level spreader to be used at the upstream end of the filter strip to evenly distribute stormwater runoff into the filter strip. The level spreader must be located at least 10 feet from building foundations.
- The standard level spreader for this application is a small stone trench filled with river rock, pea gravel, or #8 stone installed along a level contour. This stone trench should be 6” to 12” wide and 6” to 12” deep. Larger diameter stone may be required to stabilize entry points for larger contributing impervious areas.
- When applicable, the level spreader may be connected to the downspout through a T-connection to perforated pipes embedded in the stone trench.
- Alternatively, a level spreader may be constructed using manufactured landscape or playground borders/barriers (plastic or recycled material only; no lumber ties or railroad ties). This installation requires a 2” drop on the downstream side to ensure positive flow (see detail on specifications sheet).
- Ensure level spreader overflow points are protected from erosion and not blocked by vegetation.
- If the impervious drainage area to any one entry point (e.g. a downspout) is less than or equal to 300 square feet, requirement for a level spreader **may** be waived if flow will flow as a sheet through the vegetated filter strip area. In this case splash blocks or downspout protection pads can be used to introduce flow into vegetated filter strip areas instead of a level spreader. Drainage areas greater than 300 square feet require construction of the level spreader. Vegetation requirements (below) for the vegetated filter strip are the same regardless of use of level spreader or other energy dissipation.

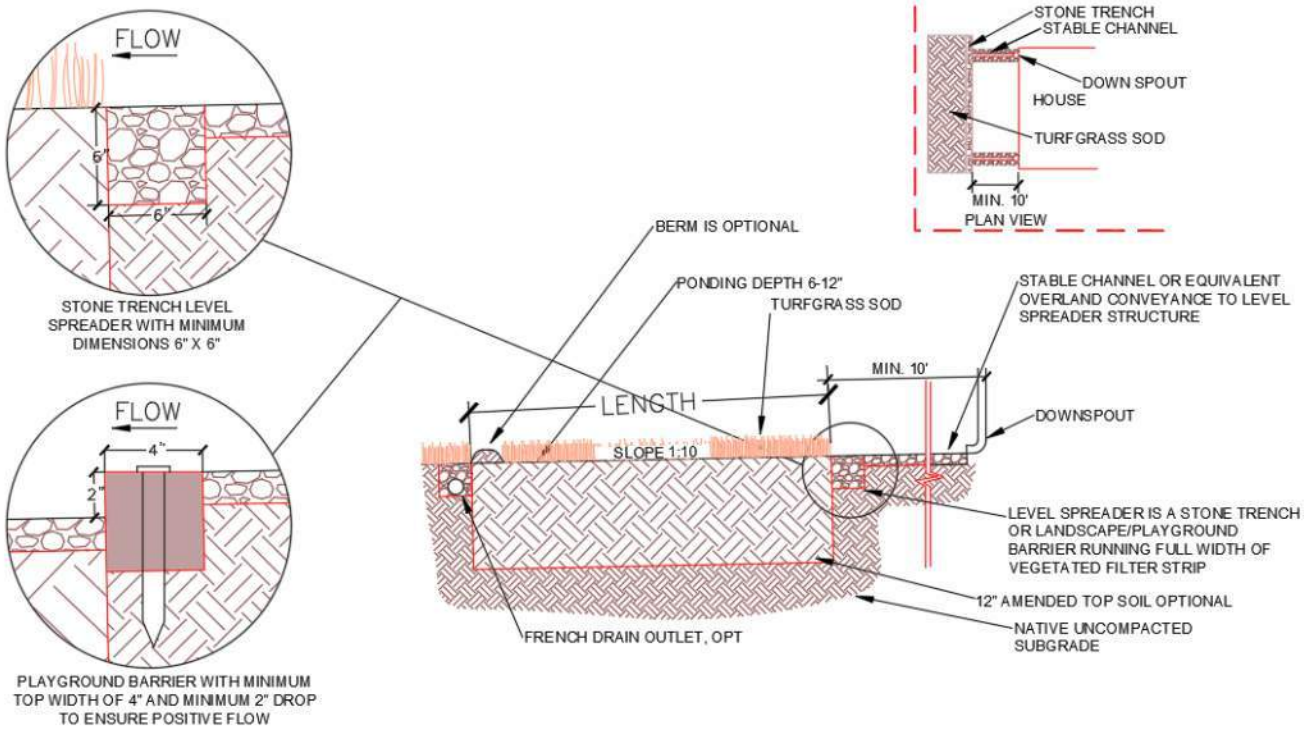
1.3.4 Vegetation

- Vegetation commonly planted on vegetated filter strips includes turf and other herbaceous vegetation.
- Choose grasses and other vegetation that will be able to tolerate the stormwater runoff rates and volumes that will pass through the vegetated filter strip.
- Vegetation used in filter strips should be able to tolerate both wet and dry conditions.
- Vegetated filter strip areas must be sodded as a part of the project if they drain to an LID practice.
- Do not use Bermuda grass. Use Zoysia or Fescue.

1.4 Maintenance

Maintain the vegetated filter strip so that it will continue to provide measurable stormwater management benefits over time.

- Water as needed to promote plant growth and survival, especially in the first two seasons.
- Provide normal turf or garden maintenance - mow, prune, and trim as needed.
- Inspect the vegetated filter strip following rainfall events. Fix erosion issues immediately.
- Remove accumulated trash, sediment, and debris.



TYPICAL COMPONENTS

CONSTRUCTION STEPS:

1. Review potential filter strip areas and layout. Filter strips should slope between 1% and 5% away from the home or other structures.
2. Amended or bermed filter strips should <u>not</u> be located uphill from or within 20 feet of a septic field. If there is a concentrated overflow, ensure it is at least 10 feet from building foundations and 20 feet from adjacent property lines.
3. Placing a filter strip over utilities is acceptable except where the amended soil option is used. In that case ensure utility locations are noted and care is taken in soil amendment actions.
4. Measure the area draining to the filter strip and determine required surface area and minimum length from the table on the next page. Determine the desired filter strip and level spreader options. **All runoff entering the filter strip must be sheet flow**.
5. Lay out and mark filter strip area as well as level spreader location.
6. Construct level spreader by filling trench with appropriate stone and noting overflow points.
7. Construct filter strip option. Install berm or prepare amended soil if applicable.
8. Construct erosion control at the flow entrance and exit points as applicable.
9. Plant dense vegetation according to plan, or sod/seed. Ensure an irrigation plan is in place.
10. Ensure temporary erosion control is in place as needed until vegetation establishment.

CITY OF GREENVILLE STORMWATER DIVISION	NAME/ADDRESS:	VEGETATED FILTER STRIP SPECIFICATIONS PAGE 1 OF 2

SKETCH LAYOUT

PROVIDE PLAN AND ELEVATION VIEWS OF VEGETATED FILTER STRIP AND HOUSE SHOWING ROOF AREA DIRECTED TO FILTER STRIP AND KEY DIMENSIONS, CONNECTIONS AND OVERFLOW RELATIVE TO PROPERTY LINE. ATTACH ADDITIONAL PAGES IF NECESSARY.

SIZING CALCULATION:

Contributing Drainage Area (square feet)	Filter Strip Type		
	Conventional	Amended Soil	Berm
	Filter Strip Area (sq ft)		
100	200	70	50
500	1000	350	250
1000	2000	670	500
2000	4000	1400	1000
3000	6000	2700	1500
4000	8000	5400	2000
5000	10000	6700	2500

MEASURE CONTRIBUTING DRAINAGE AREA AND READ FILTER STRIP AREA FOR GIVEN FILTER STRIP TYPE. FOR SPECIFIC DRAINAGE AREAS NOT LISTED ON TABLE, INTERPOLATE BETWEEN THE CLOSEST VALUES LISTED.

CONTRIBUTING DRAINAGE AREA= ________ SQ FT
FILTER STRIP AREA= _______ SQ FT
CONVENTIONAL – 25' MINIMUM LENGTH
BERM OPTION – 15' MINIMUM LENGTH

MAINTENANCE:

1. INSPECT GUTTERS AND DOWNSPOUTS REMOVING ACCUMULATED LEAVES AND DEBRIS, CLEANING LEAF REMOVAL SYSTEM(S).
2. IF APPLICABLE, INSPECT PRETREATMENT DEVICES FOR SEDIMENT ACCUMULATION. REMOVE ACCUMULATED TRASH AND DEBRIS.
3. WATER AS NEEDED TO PROMOTE PLANT GROWTH AND SURVIVAL ESPECIALLY IN THE FIRST TWO SEASONS.
4. PROVIDE NORMAL TURF OR GARDEN MAINTENANCE - MOW, PRUNE, AND TRIM AS NEEDED.
5. INSPECT THE VEGETATED FILTER STRIP FOLLOWING RAINFALL EVENTS. FIX EROSION ISSUES IMMEDIATELY.

CITY OF GREENVILLE STORMWATER DIVISION	ATTACH THIS TWO-PAGE SPECIFICATION TO HOUSE PLAN SUBMITTAL	VEGETATED FILTER STRIP SPECIFICATIONS PAGE 2 OF 2

Technical Specification for:

LID-03 MODIFIED FRENCH DRAIN

1.0 Modified French Drain

1.1 Description

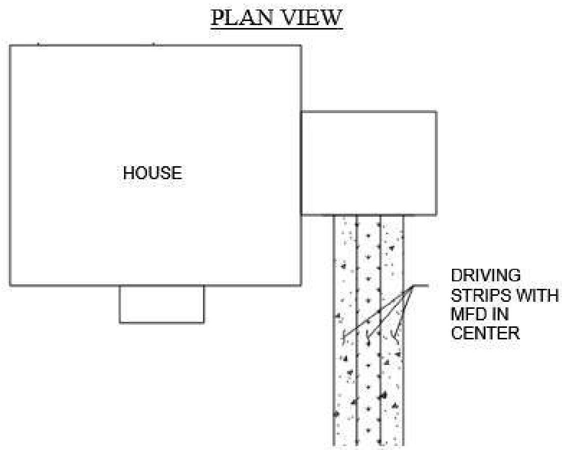
Modified French Drains (MFD) are shallow trench excavations filled with stone that are designed to intercept and temporarily store stormwater runoff until it infiltrates into the soil. When properly sized, installed, and maintained, MFDs may provide reductions in stormwater runoff and pollutant loads. They are particularly well suited to receive rooftop runoff but can also be used to receive stormwater runoff from other small impervious areas. The use of MFDs for compliance with City stormwater ordinance requirements are only allowed to address ordinance requirements for single-family residential projects. The perforated pipe is daylighted at its end allowing for overflow of larger storms and a failsafe mechanism should infiltration not be as anticipated.

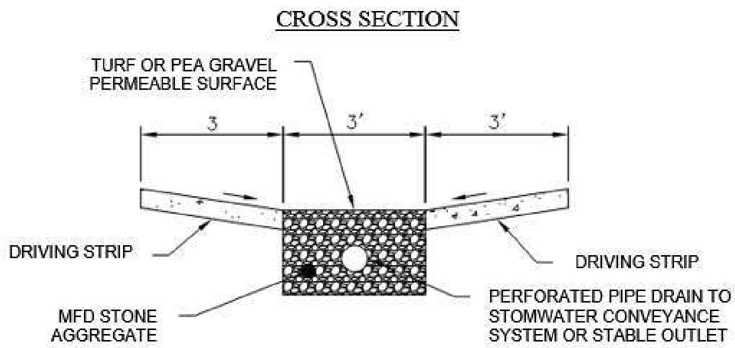
MFDs are an infiltration-based LID practice which must reliably drain to function as designed. Many of the native soils in the City of Greenville do not allow for adequate infiltration, therefore the perforated pipe drain of the MFD is required and critical to ensure the function of the MFD. The perforated pipe drain must flow to a stable outlet that daylights (emerges from the ground and is open to the air) or tie into a stormwater conveyance system. **If daylighting the perforated pipe drain is infeasible, infiltration testing must be performed (see Appendix A) to demonstrate an infiltration rate of 0.5 in/hr in order to use a MFD.** If the infiltration rate is inadequate and daylighting the perforated pipe drain is infeasible, use other LID practices. If it is infeasible to slope the MFD away from structures on site, use other LID practices.

1.2 Using Modified French Drains

- MFD trenches should be located at least 10 feet from building foundations and 20 feet from property lines. Downspout connections within 10 feet of the building that direct flow to the MFD should be constructed of non-perforated pipe to direct flow away from the structure.
- MFDs must slope away from the structures. The slope of the MFD pipe should be between 0.5% and 6%. It can be serpentine or multi-pronged in construction if sufficient slope is available.
- To reduce the chance of clogging, MFDs should drain only impervious areas, and runoff should be pretreated to remove leaves, debris, and other larger particles.
- MFD gravel trench depth and width should each be at least 18 inches and no more than 36 inches.
- MFDs should be located in a lawn or other pervious (unpaved) area and should be designed so that the top of the MFD is located as close to the surface as possible to reduce excavation.
- MFDs should not be located: (1) beneath an impervious (paved) surface; (2) above an area with a water table or bedrock less than two feet below the trench bottom; (3) over other utility lines; or, (4) uphill from or withing 20 feet of a septic field. Always call 811 to locate utility lines before you dig.

- The downstream end of the pipe must daylight for overflows more than ten feet from the property line.
- If you elect to measure infiltration rate (see Appendix A) and find it is greater than or equal to 1.0 in/hr, the MFD size can be reduced. For every 0.5 in/hr increase in measured infiltration rate above the required 0.5 in/hr, subtract ten percent of the required MFD size, as measured in contributing area captured (square feet) which determines the dimensions of the MFD.
- MFDs may be used in a variety of locations based on site constraints. One application is to install the MFD adjacent to a driveway or in the center of a split track driveway, such that the driveway is sloped to drain into the MFD. The split track driveway application is shown below:





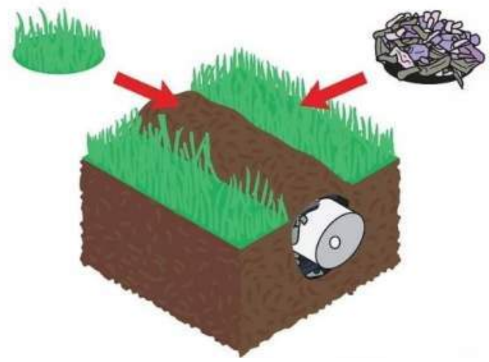
1.3 Construction

- As a rule-of-thumb there should be 21 cubic feet of stone for every 100 square feet of rooftop (0.21 cubic feet per square foot of rooftop). See specifications sheet for MFD design guidance.
- Actual installed width and depth of MFD may vary between 18 and 36 inches and should match cross section shown on specification sheet.
- The sides of the excavation should be trimmed of all large roots that will hamper the installation of the permeable drainage fabric used part way down the sides and above the gravel layer on top of the MFD.
- The native soils along the bottom of the MFD should be scarified or tilled to a depth of 3 to 4 inches.
- Install geotextile filter fabric between native soils and the washed #57 stone and perforated pipe.
- Fill the MFD with clean, washed #57 stone embedding a 6-inch diameter perforated pipe in the top of the stone such that the stone covers the top of the pipe. #57 stone averages ½ inch to 1-½ inches.
- The pipe should have 3/8-inch perforations, spaced 6 inches on center, and have a minimum slope of 0.5% and a maximum slope of 6%.

- The perforated pipe must daylight at the downstream end of the trench or adequate infiltration must be demonstrated through testing (see Section 1.1).
- A pop-up emitter at the end of the perforated pipe is a recommended addition to disperse flow.
- An overflow, such as a vegetated filter strip or grass channel, should be designed to convey the stormwater runoff generated by larger storm events safely out of the downstream end of the MFD.
- Place permeable geotextile filter fabric over gravel to keep soil or pea gravel from migrating into the gravel and filling the pore spaces and leave four to six inches above the pipe to the ground surface.
- Cover with topsoil and sod or with pea gravel.
- For rooftop runoff, install one or more leaf screen options prior to entering the MFD to prevent leaves and other large debris from clogging the MFD. For driveway or parking runoff a screened inlet grate over a sump or pea gravel pit can be used to settle out material prior to entering the pipe.

1.3.1 Vegetation

- MFDs are normally covered with topsoil and managed turf or other herbaceous vegetation.
- As an alternative, the area above the surface of the MFD may be covered with pea gravel (or larger depending on the inflow rates) to allow for incidental lateral inflow along the edge of ground level impervious surfaces.
- The downstream end of the pipe must be stabilized and can be landscaped for aesthetics.

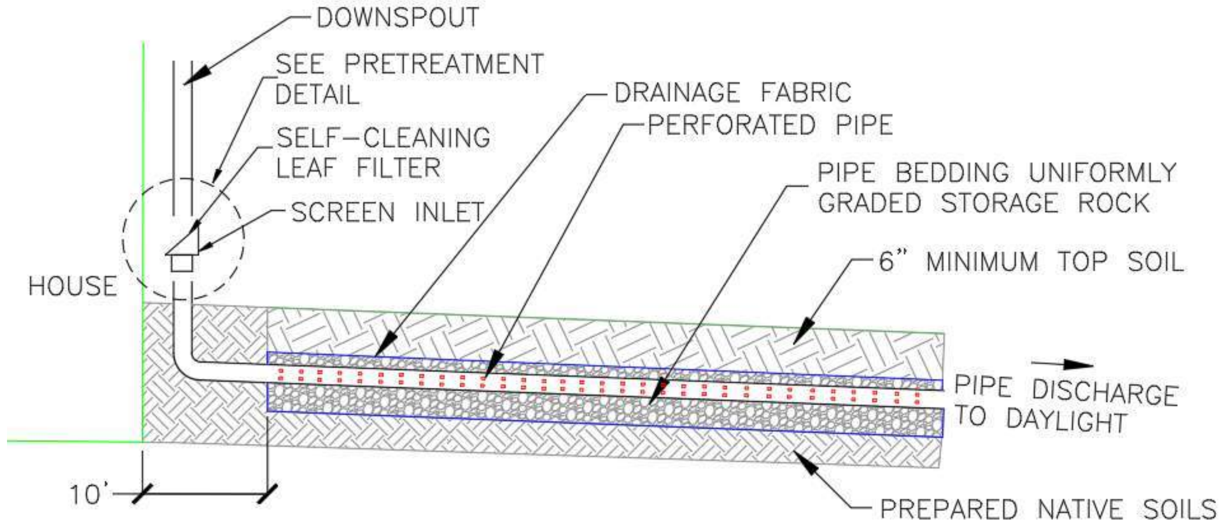


1.4 Maintenance

Annual maintenance is important for MFDs.

- Inspect gutters/downspouts removing accumulated leaves and debris, cleaning leaf removal system(s).
- Inspect any pretreatment devices for sediment accumulation. Remove accumulated trash and debris.
- Inspect MFD following a large rainfall event to ensure overflow is operating and flow is not causing problems.

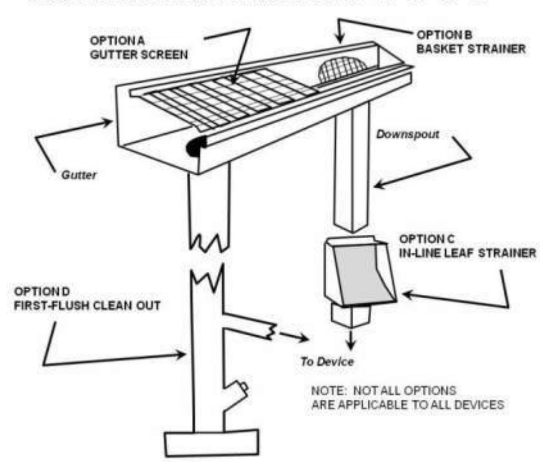
TYPICAL COMPONENTS (ATTACH MANUFACTURER'S SPECIFICATIONS)



CONSTRUCTION STEPS:

1. Review potential MFD areas and layout. MFDs should slope between 0.5% and 6% away from the structure and should <u>not</u> be located: (1) beneath an impervious (paved) surface; (2) above an area with a water table or bedrock less than two feet below the trench bottom; (3) over other utility lines; or, (4) uphill from or within 20 feet of a septic drain field. Ensure outlet daylights at least 20 feet from property line.
2. Measure the area draining to the MFD and calculate the required volume of stone on the next page.
3. Determine the required length, width, and gravel depth to provide the required volume of stone aggregate. Consider routing of flows, excavation depth, and space constraints on the site.
4. Infiltration rate testing is not necessary when using the required perforated pipe drain with a stable outlet that daylights. See specification Section 1.1 for detailed underdrain and infiltration requirements.
5. A pop-up emitter at the end of the perforated pipe is a recommended addition to disperse flow.
6. If a perforated pipe drain with positive slope/flow is infeasible, MFDs cannot be used.
7. If the infiltration rate is greater than or equal to 1.0 in/hr, the contributing drainage area (square feet) may be decreased 10% for every 0.5 in/hr infiltration rate in excess of the required 0.5 in/hr. See Appendix A for soil infiltration testing and requirements.
8. Measure elevations and lay out the MFD to the required dimensions, marking the route and required excavation depths. Often a level line (torpedo level) is used.
9. Remove sod using a sod cutter if appropriate. Excavate ditch to the depth of the gravel plus six inches for topsoil/pea gravel. Be careful not to compact soils in the bottom. Level the bottom laterally as much as possible to maximize infiltration area. Roughen bottom to a depth of at least three inches and trim roots.
10. Place and secure geotextile filter fabric on bottom and down sides of the excavation leaving enough to fold over the top below the soil and turf.
11. Place gravel in ditch to planned depth placing the pipe three inches deep in the upper portion of the gravel. Then place gravel until it covers the pipe.
12. Fold drainage fabric over top of pipe and stone.
13. Place topsoil and sod or pea gravel.
14. Cut and route downspouts or other rainwater delivery components, leaf screen option(s) chosen (**circle selected options in Pretreatment Options Detail figure**). Strap and support as needed.
15. Create a safe overflow at least 20 feet from your property edge and ensure it is protected from erosion.

CIRCLE ONE OR MORE OPTIONS USED A B C D



PRETREATMENT OPTIONS DETAIL

CITY OF GREENVILLE STORMWATER DIVISION	NAME/ADDRESS:	MFD SPECIFICATIONS PAGE 1 OF 2

SKETCH LAYOUT

PROVIDE PLAN AND ELEVATION VIEWS OF MFD AND HOUSE SHOWING ROOF AREA DIRECTED TO MFD AND KEY DIMENSIONS, CONNECTIONS AND OVERFLOW RELATIVE TO PROPERTY LINE. ATTACH ADDITIONAL PAGES IF NECESSARY.

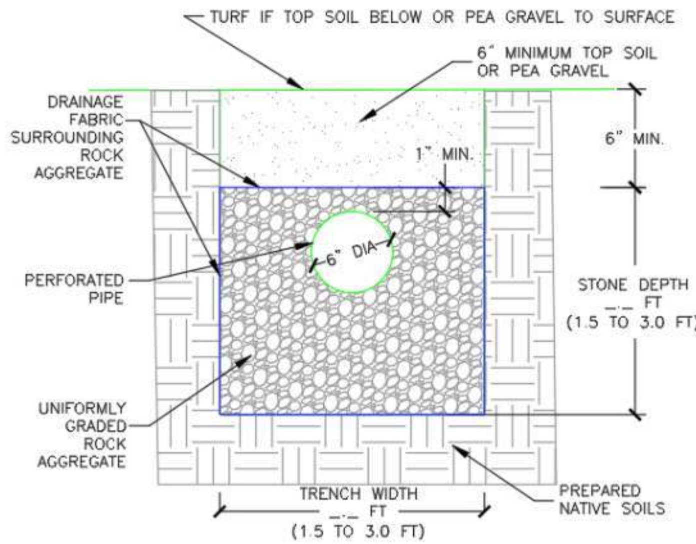
VOLUME REQUIRED:
0.21 CU FT OF STONE AGGREGATE TRENCH PER SQ FT OF CONTRIBUTING ROOF DRAINAGE AREA (21 CU FT PER 100 SF OF ROOF AREA)
_______ SQ FT ROOF AREA X 0.21 = _______ **FT^3**

DIMENSIONS OF MFD:
DEPTH OF STONE MEDIA= _______ FT
(1.5 TO 3.0 FT)
WIDTH OF MFD TRENCH= _______ FT
(1.5 TO 3.0 FT)
TOTAL LENGTH OF MFD= _______ FT
(SITE SPECIFIC)

VOLUME PROVIDED:
_____ FT X _____ FT X _____ FT = ________ **FT^3**

IS VOLUME PROVIDED ≥ VOLUME REQUIRED?
________ **(YES/NO)**

MFD CROSS SECTION: LABEL TRENCH WIDTH AND STONE DEPTH DIMENSIONS BELOW.



MAINTENANCE:
1. INSPECT GUTTERS AND DOWNSPOUTS REMOVING ACCUMULATED LEAVES AND DEBRIS, CLEANING LEAF REMOVAL SYSTEM(S).
2. IF APPLICABLE, INSPECT PRETREATMENT DEVICES FOR SEDIMENT ACCUMULATION. REMOVE ACCUMULATED TRASH AND DEBRIS.
3. INSPECT MFD FOLLOWING A LARGE RAINFALL EVENT TO ENSURE OVERFLOW IS OPERATING AND FLOW IS NOT CAUSING EROSION OR FLOODING PROBLEMS.

CITY OF GREENVILLE STORMWATER DIVISION	ATTACH THIS TWO-PAGE SPECIFICATION TO HOUSE PLAN SUBMITTAL	MFD SPECIFICATIONS PAGE 2 OF 2

Technical Specification for:

LID-04 PERMEABLE PAVERS

1.0 Permeable Pavers

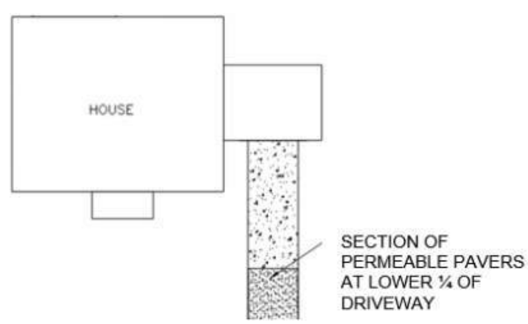
1.1 Description

Permeable pavers are an alternative to traditional paving surfaces that can decrease stormwater runoff. They are well suited for use when constructing sidewalks, parking areas, patios, and driveways. Permeable pavers consist of permeable interlocking or grid concrete pavers underlain by a drainage layer. A permeable paver system allows stormwater runoff to pass in between the paver surface and into an underlying stone reservoir, where it is temporarily stored and allowed to infiltrate into the underlying soils. When properly sized, installed, and maintained, permeable pavers may provide reductions in stormwater runoff and pollutant loads.

Permeable pavers are an infiltration-based LID practice which must reliably drain to function as designed. Many of the native soils in the City of Greenville do not allow for adequate infiltration, therefore a perforated underdrain is required. The perforated underdrain must flow to a stable outlet that daylights (emerges from the ground and is open to the air) or tie into a stormwater conveyance system. **If installation of an underdrain that daylights is infeasible, infiltration testing must be performed (see Appendix A) to demonstrate an infiltration rate of 0.5 in/hr in order to use permeable pavers.** If the infiltration rate is inadequate and an underdrain that daylights is infeasible, use other LID practices.

1.2 Using Permeable Pavers

- Permeable pavers should not be located: (1) above an area with a water table or bedrock less than two feet below the gravel bottom; (2) over other utility lines; or, (3) uphill from or within 20 feet of a septic field. Always call 811 to locate utility lines before you dig.
- Permeable pavers should drain only impervious areas. Drainage from other areas onto the pavers will eventually clog them.
- Permeable paver systems should be installed on slopes less than 6% to help ensure even distribution of runoff over the infiltration surface and should slope away from structures.
- Permeable pavement may be used for a portion of a driveway or parking area, ensuring it is downgradient from impervious areas that are to be treated. For example, the lower ¼ of a driveway could be permeable pavement that treats the upper ¾ of the driveway. See example at right.
- Long driveways may be treated with multiple strips or sections of permeable pavers, located downgradient from impervious areas that are to be treated.



1.3 Construction

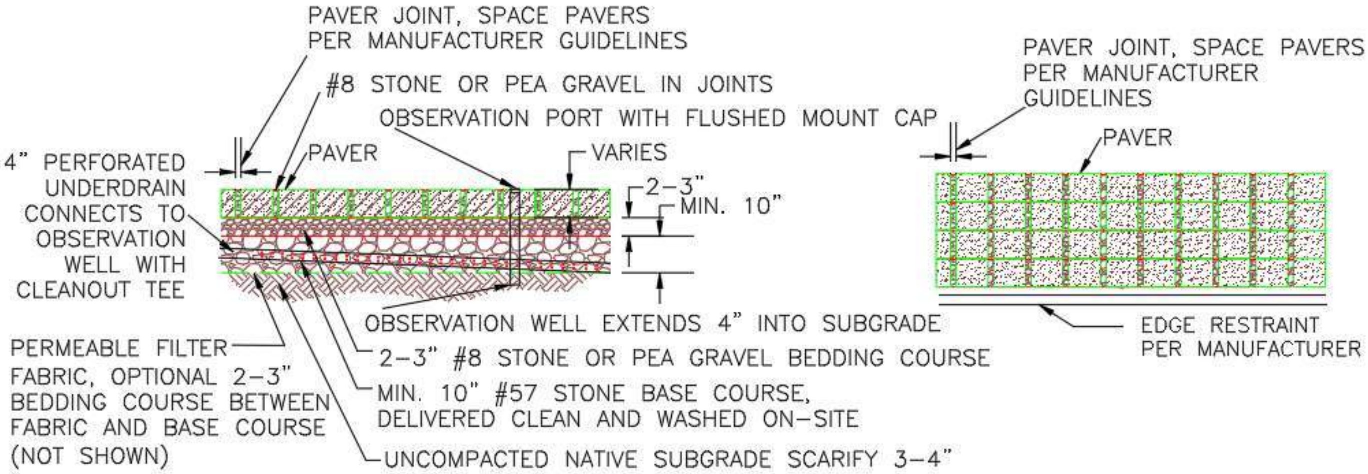
- Permeable pavers are sized based on the volume of stone needed in the stone aggregate base course layer to provide treatment. As a rule-of-thumb there should be 21 cubic feet of stone for every 100 square feet of drainage area (0.21 cubic feet per square foot of drainage area). See specifications sheet for design calculation guidance.

- Actual installed dimensions of the permeable pavement system and stone aggregate base course layer may vary and should be as described on the specification sheet and shown on the site layout sketch.
- The drainage area to the permeable pavement practice must be stabilized prior to installation.
- Permeable paver systems require multiple layers. Typical layers of an installed system are listed below, from top to bottom of the system. When available, manufacturer's instructions should be followed in lieu of these typical guidelines.
  - The top course consists of the pavers and a crushed aggregate material swept between the paver joints, such as #8 stone or 1/8" to 3/8" pea gravel. The thickness of this layer varies depending upon the depth of the paver.
  - The bedding course consists of 2 to 3 inches of #8 stone or 1/8" to 3/8" pea gravel. The bedding course provides a level bed for setting the pavers evenly.
  - The stone aggregate base course consists of washed #57 stone installed with a minimum depth of 10 inches. The aggregate base course acts as a reservoir to provide stormwater storage capacity.
  - An optional bedding course of 2 to 3 inches of #8 stone or 1/8" to 3/8" pea gravel may be installed between the base course and filter fabric.
  - A permeable drainage filter fabric should be used to separate the stone layers and the subgrade, following any applicable manufacturer's specifications.
  - The subgrade layer is the layer of native soils below the stone layers and the permeable drainage filter fabric. The subgrade soil layer should be prepared by scarifying or tilling to a depth of 3 to 4 inches. The subgrade should be level to encourage infiltration across the entire paver area.
- Installation of the system should include a horizontal 4" perforated underdrain and a vertical observation well that extends 4" into subgrade, connects to the underdrain with cleanout tee, and ends at paver surface with a flushed mount cap to allow access.
- In all cases the above should be the minimum specifications for the pervious paver system. Manufacturer's specifications may require larger depths or alternate materials. These systems are permitted as long as an infiltration rate of 6 in/hr is maintained and the system can drain in 72 hours.
- If you elect to measure infiltration rate (see Appendix A) and find it is greater than or equal to 1.0 in/hr, the required stone aggregate base course volume of the permeable paver system can be reduced. For every 0.5 in/hr increase in measured infiltration rate above the required 0.5 in/hr, subtract ten percent of the required stone aggregate base course volume.

1.4 Maintenance

Maintenance is very important for permeable pavers systems, particularly in terms of ensuring that they continue to provide measurable stormwater management benefits over time.

- Remove accumulated sediment and debris from joint space monthly.
- Observe the permeable paver system for excessive ponding during storm events and repair as needed.
- Vacuum, sweep, or blow permeable paver surface quarterly to keep the surface free of sediment. New #8 stone may need to be swept into the space between stones as needed.
- Inspect permeable paver surface for deterioration annually. Repair or replace any damaged areas as needed.

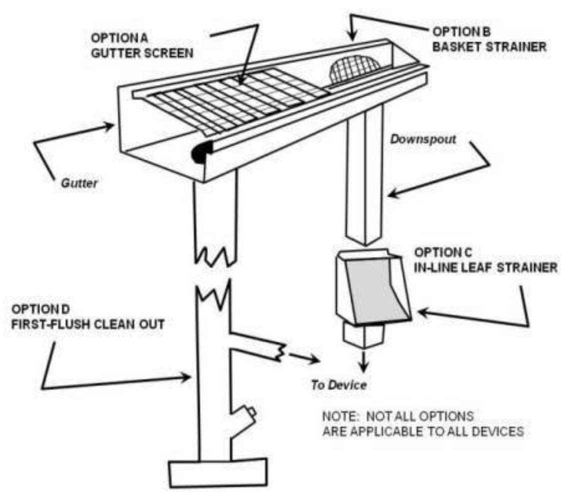


TYPICAL COMPONENTS (ATTACH MANUFACTURER'S SPECIFICATIONS)

CONSTRUCTION STEPS:

1. Review potential paver areas and layout. Pavers should slope less than 6% away from the structure and should not be located: (1) above an area with a water table or bedrock less than two feet below the trench bottom; (2) over utility lines; or, (3) uphill from or within 20 feet of a septic field.
2. Measure the area draining to the pavers and determine required paver dimensions from the calculation on the next page based on the depth of the base course stone aggregate storage layer.
3. Infiltration rate testing is not necessary when using the required perforated underdrain. If an underdrain is infeasible, see Appendix A for soil infiltration rate testing and requirements.
4. If the infiltration rate is greater than or equal to 1.0 in/hr, the required stone aggregate base course volume (cubic feet) may be decreased 10% for every 0.5 in/hr infiltration rate in excess of the required 0.5 in/hr. See Appendix A for soil infiltration testing and requirements.
5. Excavate area to appropriate depth with level subgrade (not to exceed 2% in any direction) and scarify soil to 3-4".
6. Place and secure geotextile filter fabric (Mirafi #140 N or equivalent) on bottom and down sides of the excavation.
7. Install 4" perforated underdrain and observation well. Observation well extends 4" into subgrade, connects to underdrain with cleanout tee, and ends at paver surface with flushed mount cap to allow access.
8. If desired, optional 2-3" bedding course layer of #8 stone or pea gravel may be installed under base course.
9. Place and level washed #57 stone aggregate for base course storage layer to planned depth. (10" min.)
10. Place and level 2-3" #8 stone or pea gravel bedding layer for level paver surface installation.
11. Lay paving stone one at a time or using mechanical placement as applicable. Cut stone at edges to fit.
12. Install edge restraints per manufacturer's specifications.
13. Sweep more #8 stone or pea gravel into stone joints until filled and even.

CIRCLE ONE OR MORE OPTIONS USED A B C D



PRETREATMENT OPTIONS DETAIL

14. If applicable, cut and route downspouts or other rainwater delivery components, and indicate leaf screen option(s) chosen (**circle selected options in Pretreatment Options Detail**). Strap and support as needed.
15. In all cases the above should be the minimum specifications for the pervious paver system. Manufacturer's specifications may require larger depths or alternate materials. These systems are permitted as long as an infiltration rate of 6 in/hr is maintained and the system can drain in 72 hours.

CITY OF GREENVILLE STORMWATER DIVISION	NAME/ADDRESS:	PERMEABLE PAVER SPECIFICATIONS PAGE 1 OF 2

SKETCH LAYOUT

PROVIDE PLAN AND ELEVATION VIEWS OF PERVIOUS PAVER AND HOUSE SHOWING ROOF AREA DIRECTED TO PAVERS AND KEY DIMENSIONS, CONNECTIONS AND ANY APPLICABLE OVERFLOW RELATIVE TO PROPERTY LINE. ATTACH ADDITIONAL PAGES IF NECESSARY.

PROVIDE ADEQUATE VOLUME OF WASHED STONE AGGREGATE IN THE BASE COURSE LAYER (MIN. DEPTH 10")

VOLUME REQUIRED:
0.21 CU FT OF STONE AGGREGATE BASE COURSE PER SQ FT OF CONTRIBUTING DRAINAGE AREA (21 CU FT PER 100 SF)

_______ SQ FT DRAINAGE AREA X 0.21 =
_______ **FT^3 REQUIRED**

DIMENSIONS OF BASE COURSE LAYER:
DEPTH OF STONE= _______ FT
(MIN. DEPTH = 10" = 0.83')
WIDTH OF PAVER AREA= _______ FT
LENGTH OF PAVER AREA= _______ FT

VOLUME PROVIDED:
_____ FT X _____ FT X _____ FT =
________ **FT^3 PROVIDED**

IS VOLUME PROVIDED ≥ VOLUME REQUIRED? ________ (YES/NO)

MAINTENANCE:

1. REMOVE ACCUMULATED SEDIMENT AND DEBRIS FROM JOINT SPACE MONTHLY. REMOVE WEEDS BY SPRAYING OR PULLING BY HAND.
2. INSPECT PERMEABLE PAVER SURFACE FOR DETERIORATION ANNUALLY. REPAIR OR REPLACE ANY DAMAGED AREAS AS NEEDED.
3. OBSERVE THE PERMEABLE PAVER SYSTEM FOR EXCESSIVE PONDING DURING STORM EVENTS AND REPAIR AS NEEDED.
4. VACUUM, SWEEP, OR BLOW PERMEABLE PAVER SURFACE QUARTERLY TO KEEP THE SURFACE FREE OF SEDIMENT. DO NOT PRESSURE WASH.
5. NEW STONE MAY NEED TO BE SWEPT INTO THE JOINTS AS NEEDED.
6. DO NOT APPLY SAND DURING WINTER.
7. DO NOT WASH VEHICLES OR STOCKPILE MATERIALS/CHEMICALS ON PAVER SURFACE.
8. BAG GRASS CLIPPINGS OR DIRECT THEM AWAY FROM PAVERS TO PREVENT CLOGGING.

CITY OF GREENVILLE STORMWATER DIVISION	ATTACH THIS TWO-PAGE SPECIFICATION TO HOUSE PLAN SUBMITTAL	PERMEABLE PAVER SPECIFICATIONS PAGE 2 OF 2

Technical Specification for:

LID-05 RAIN GARDENS

1.0 Rain Gardens

1.1 Description

Rain gardens are small, landscaped depressions that are filled with a mix of native soil and compost and are planted with trees, shrubs and other garden-like vegetation. They are designed to temporarily store stormwater runoff from rooftops, driveways, patios and other areas around your home while reducing runoff rates and pollutant loads in your local watershed. A rain garden can be a beautiful and functional addition to a landscape plan. When properly sized, installed, and maintained, rain gardens may provide reductions in stormwater runoff and pollutant loads.

Rain gardens are an infiltration-based LID practice which must reliably drain to function as designed. Many of the native soils in City of Greenville do not allow for adequate infiltration, therefore a perforated underdrain is required. The perforated underdrain must flow to a stable outlet that daylights (emerges from the ground and is open to the air) or tie into a stormwater conveyance system. **If installation of an underdrain that daylights is infeasible, infiltration testing must be performed (see Appendix A) to demonstrate an infiltration rate of 0.5 in/hr in order to use a rain garden.** If the infiltration rate is inadequate and an underdrain that daylights is infeasible, use other LID practices.

1.2 Using Rain Gardens

- Rain gardens should be located to receive the maximum amount of stormwater runoff from impervious surfaces, and where downspouts or driveway runoff can enter garden flowing away from the home.
- Swales, berms, or downspout extensions may be helpful to route runoff to the rain garden.
- Locate at least 10 feet from building foundations, not within the public right of way, away from utility lines, not uphill from or within 20 feet of septic fields, and not near a steep bluff edge. Call 811 before you dig to locate the utility lines on your property.
- Rain gardens on steep slopes (>10%) may require an alternative design with terracing.

1.3 Construction

- The size of the rain garden will vary depending on the impervious surface draining to it and the depth of the filter media. See sizing table on specification sheet.
- A maximum ponding depth of 6 inches is allowed within rain gardens. On average, rain gardens drain within a day which will not create a mosquito problem.
- Design rain garden entrance to immediately intercept inflow and reduce its velocity with stones, dense hardy vegetation or by other means.
- If sides are to be mowed rain gardens should be designed with side slopes of 3:1 (H:V) or flatter.

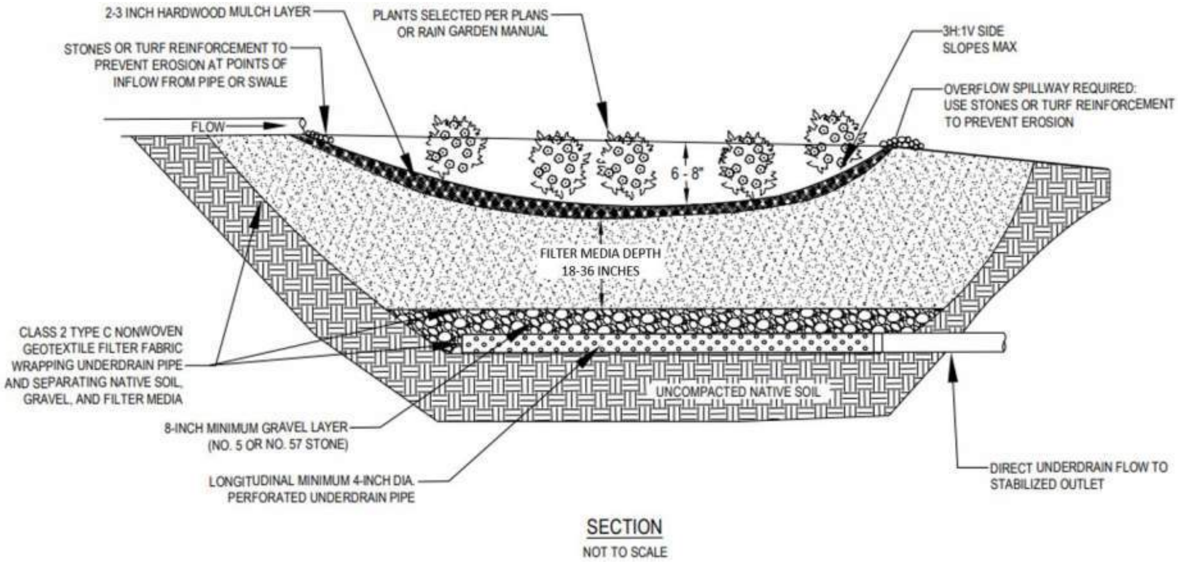
- For best results, it is suggested to test your soil characteristics as you would for a garden, or contact the Clemson Home & Garden Information Center for help https://hgic.clemson.edu/factsheet/soil-testing/.
- See Appendix B for filter media recommendations and local suppliers.
- A mulch layer consisting of 2-3 inches of non-floatable organic mulch (fine shredded hardwood mulch, pine straw, or leaf compost) should be included on the surface of the rain garden. Pine bark and wood chips should not be used.
- Often rain gardens have a better appearance and can be more easily maintained if they have defined edges, similar to a normal garden.
- The overflow from the rain garden should be non-eroding and can consist of a small berm or even an inlet grate set at the proper elevation in the garden. The grate should be set at a slant or be domed to allow clogging debris to fall off.
- If you elect to measure infiltration rate (see Appendix A) and find it is greater than or equal to 1.0 in/hr, the rain garden size can be reduced. For every 0.5 in/hr increase in measured infiltration rate above the required 0.5 in/hr, subtract ten percent of the required rain garden area (square feet).

1.3.1 Vegetation

- Vegetation commonly planted in rain gardens includes native trees, shrubs and other herbaceous vegetation. When developing a landscaping plan, you should choose vegetation that will be able to stabilize soils and tolerate the stormwater runoff rates and volumes that will pass through the rain garden.
- Vegetation used in rain gardens should also be able to tolerate both wet and dry conditions. See The Carolina Yards Plant Database (https://www.clemson.edu/extension/carolinayards/plant-database/index.html) and The South Carolina Waterways Fact Sheet Series (https://hgic.clemson.edu/category/water/) for more information on grasses and other plants that are appropriate for use in rain gardens. Links are provided to assist with finding information but may change. If the specific link does not work, search Clemson University extension online publications for rain garden planting information.
- As with any garden in the first season the vegetation may require irrigation to become well established. It may be appropriate to plant more densely than a normal garden to obtain the benefit of plant soil stabilization and evapotranspiration as soon as possible.

1.4 Maintenance

Routine garden maintenance should include weeding, deadheading, replacing dead plants, and replenishing mulch when depleted. Catching areas of erosion is also important as is correcting standing water problems. If standing water persists it may be necessary to place a perforated underdrain in the garden daylighting downstream.



TYPICAL COMPONENTS

CONSTRUCTION STEPS:

1. Locate rain garden(s) where downspouts or driveway runoff can enter garden flowing away from the home. Locate at least 10 feet from building foundations, away from utility lines, not uphill from or within 20 feet of septic fields, and not near a steep bluff edge.
2. Measure the area draining to the planned garden and determine required rain garden surface area from the table on the next page and your planned excavation depth.
3. Infiltration rate testing is not necessary when using the required perforated underdrain. If an underdrain is infeasible, see Appendix A for soil infiltration rate testing and requirements.
4. If the infiltration rate is greater than or equal to 1.0 in/hr, the area of rain garden (square feet) may be decreased 10% for every 0.5 in/hr infiltration rate in excess of the required 0.5 in/hr. See Appendix A for soil infiltration testing and requirements.
5. Measure elevations and stake out the garden to the required dimensions ensuring positive flow into garden, the overflow elevation allows for six inches of ponding, and the perimeter of the garden is higher than the overflow point. If the garden is on a gentle slope a berm at least two feet wide can be constructed on the downhill side and/or the garden can be dug into the hillside taking greater care for erosion control at the garden inlet(s).
6. Remove turf or other vegetation in the area of the rain garden. Excavate garden being careful not to compact soils in the bottom of the garden. Level bottom of garden to maximize infiltration area.
7. See Appendix B for description of the recommended filter media and local suppliers.
8. Fill rain garden with the required filter media, leaving the surface eight inches below your highest surrounding surface. Eight inches allows for 6 inches ponding and 2” of mulch. The surface of the rain garden should be as close to level as possible.
9. Build a berm at the downhill edge and sides of the rain garden with the remaining subsoil. The top of the berm needs to be level and set at the maximum ponding elevation.
10. Plant the rain garden using a selection of plants described previously in specification section 1.3.1.
11. Mulch the surface of the rain garden with two to three inches of non-floating organic mulch. The best choice is finely shredded hardwood mulch.
12. Water all plants thoroughly. As in any new garden or flower bed, regular watering will likely be needed to establish plants during the first growing season.
13. During construction build the inlet feature as a pipe directly connected to a downspout or use a rock lined swale with a gentle slope. Use of an impermeable liner under the rocks at the end of the swale near the house is recommended to keep water from soaking in at that point. Test the drainage of water from the source to the garden prior to finishing.
14. Create an overflow at least 10 feet from building foundations and ensure it is protected from erosion.

CITY OF GREENVILLE STORMWATER DIVISION	NAME/ADDRESS:	RAIN GARDEN SPECIFICATIONS PAGE 1 OF 2

SKETCH LAYOUT

PROVIDE PLAN VIEWS OF RAIN GARDEN AND HOUSE SHOWING DRAINAGE AREA DIRECTED TO RAIN GARDEN AND KEY DIMENSIONS AND OVERFLOW AREA RELATIVE TO PROPERTY LINE. ATTACH ADDITIONAL PAGES IF NECESSARY.

SIZING CALCULATION:

Contributing Drainage Area (square feet)	Depth of Filter Media (inches)			
	18	24	30	36
	Area of Rain Garden (square feet)			
100	6.6	5.7	5.1	4.6
500	35	30	25	23
1000	65	60	50	45
2000	135	115	100	90
3000	200	170	150	140
4000	260	230	200	185
5000	330	290	255	230

MEASURE CONTRIBUTING DRAINAGE AREA AND READ RAIN GARDEN AREA FOR GIVEN MEDIA DEPTH. FOR SPECIFIC DRAINAGE AREAS NOT LISTED ON TABLE, INTERPOLATE BETWEEN THE CLOSEST VALUES LISTED.

CONTRIBUTING DRAINAGE AREA= ________ SQ FT
DEPTH OF FILTER MEDIA= _________ INCHES
AREA OF RAIN GARDEN= _______ SQ FT

MAINTENANCE:

1. IRRIGATE VEGETATION AS NEEDED IN FIRST SEASON
2. REMOVE WEEDS
3. REPLACE UNSUCCESSFUL PLANTINGS
4. REPLENISH MULCH
5. REPAIR ERODED AREAS
6. RAKE CLOGGED SURFACE TO RESTORE INFILTRATION
7. MONITOR RAIN GARDEN FOR APPROPRIATE DRAINAGE TIMES; IF GARDEN DOES NOT DRAIN, UNDERDRAIN MAINTENANCE OR MODIFICATIONS MAY BE NECESSARY

CITY OF GREENVILLE STORMWATER DIVISION	ATTACH THIS TWO-PAGE SPECIFICATION TO HOUSE PLAN SUBMITTAL	RAIN GARDEN SPECIFICATIONS PAGE 2 OF 2

Technical Specification for:

LID-06 VEGETATED BUFFER

1.0 Vegetated Buffer

1.1 Description

A vegetated buffer is an undisturbed natural area along the lot perimeter which filters runoff, encourages infiltration, and functions as a LID practice. Vegetated buffers may also provide protection of waterbodies when they are located along a lake, wetland, creek or stream. Development is restricted or prohibited in the vegetated buffer to prevent impacts to the waterbody or adjacent properties. In addition, the vegetated buffer provides the following:

- Protection to the overall stream or waterbody quality by providing shade for the stream or waterbody (if present),
- Natural habit for wildlife, and
- A setback from the stream or waterbody, when applicable, to prevent damage to structures or improved property due to flooding or changes in the stream or waterbody.

Ideally, vegetated buffers are natural and undisturbed. When a buffer must be disturbed (or has previously been disturbed), promptly replant a dense cover of strong rooted grasses, native plants, and native trees.

1.2 Using Vegetated Buffers

- The most effective natural undisturbed vegetated buffers are those that consist of undisturbed natural vegetation, including maintaining the original tree line along the stream or channel banks, when applicable.
- The buffer should remain undisturbed to the maximum extent practical. Any area that is temporarily disturbed should be immediately replanted with a dense cover of strong rooted natural grasses, native plants, and native trees.
- Buffers may also be created or enhanced by planting new vegetation of native varieties.
- The ideal slope of the buffer is less than 8% to prevent flows that may cause erosion of the buffer and/or stream bank.
- The length of the buffer should be no less than 25 feet. If there is a permeable berm at the lower end, the length of the buffer should be no less than 15 feet. Note that bermed vegetated buffers should not be located uphill from or within 20 feet of a septic field.

1.3 Construction

- Measure the rooftop and any other area that is going to be directed to the vegetated buffer. See sizing table on specifications sheet. From the site layout drainage area, select the size and type of buffer from the table.
- There are three types of buffers: disturbed, undisturbed, and berm. Undisturbed conditions or a berm reduces the required size of the stream buffer, as shown in the sizing table.
- Undisturbed buffers are likely to be less compacted and more likely to contain dense, well-established, vegetation. For these reasons, undisturbed buffers typically provide better stream protection (when applicable), infiltration, and pollutant removal.
- For example, a 1,000 square foot rooftop with a disturbed buffer would require at least 2,000 square feet of area with a minimum flow length of 25 feet. The use of an undisturbed buffer reduces the required area to 670 square feet, still with a minimum flow length of 25 feet. If a berm is added to undisturbed conditions, it can have a surface area of 500 square feet and have a minimum flow length of 15 feet.

1.3.1 Berm Design Option

- Buffer area can be further reduced through the use of a permeable berm at the bottom end of the buffer. The permeable berm is used to temporarily store stormwater runoff within the buffer, which increases the infiltration and reduces the required width of the buffer.
- Permeable berms should be constructed of well drained soils (sand, gravels, and sandy loams) that support plant growth and should be no more than 12” high.
- Appropriately sized outlets should be provided within permeable berms to ensure that the buffer will drain within 24 hours following the end of a rainfall event.
- A stone-protected overflow area through the berm may be used to manage the stormwater runoff generated by large storm events. The overflow point must be at least 10 feet from building foundations and 20 feet from the property line if flow is onto adjoining property. Erosion protection is critical.
- Bermed vegetated buffers should not be located uphill from or within 20 feet of a septic field.

1.3.2 Level Spreader

- All vegetated buffers require a level spreader to be used at the upstream end of the buffer to evenly distribute stormwater runoff into the vegetated buffer. The level spreader must be located at least 10 feet from building foundations.
- The standard level spreader for this application is a small stone trench filled with river rock, pea gravel, or #8 stone installed along a level contour. This stone trench should be 6” to 12” wide and 6” to 12” deep. Larger diameter stone may be required to stabilize entry points for larger contributing impervious areas.
- When applicable, the level spreader may be connected to a downspout through a T-connection to perforated pipes embedded in the stone trench.

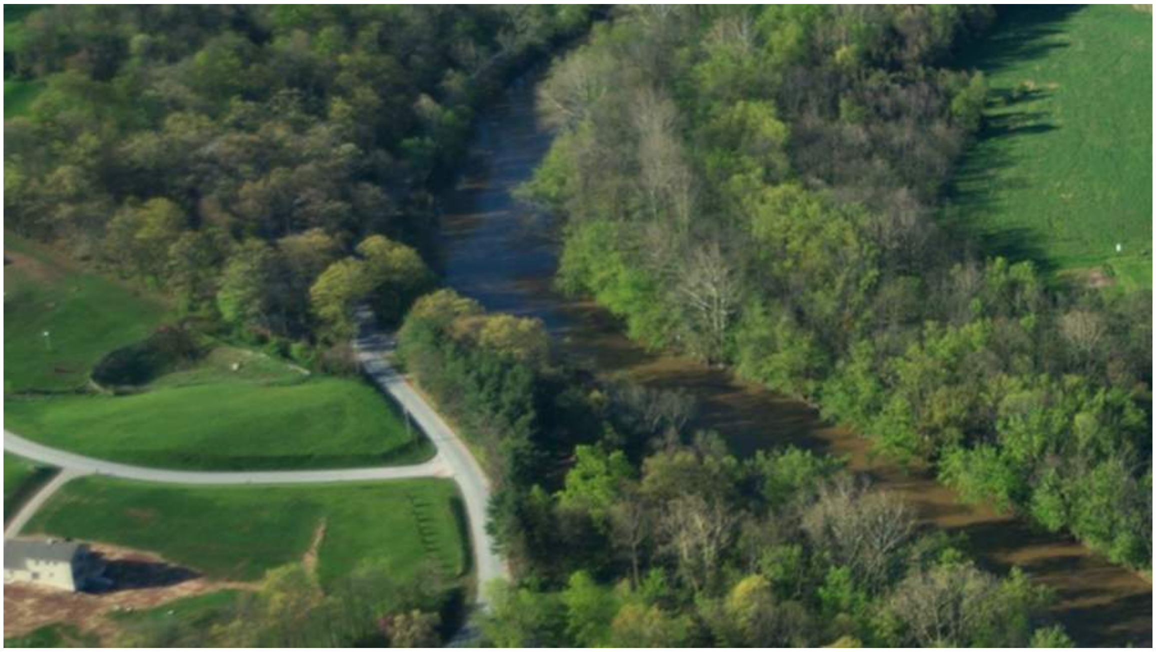
- Alternatively, a level spreader may be constructed using manufactured landscape or playground borders/barriers (plastic or recycled material only; no lumber ties or railroad ties). This installation requires a 2” drop on the downstream side to ensure positive flow (see detail on specifications sheet).
- Ensure level spreader overflow points are protected from erosion and not blocked by vegetation.
- If the impervious drainage area to any one entry point (e.g. a downspout) is less than or equal to 300 square feet, requirement for a level spreader **may** be waived if flow will flow as a sheet through the vegetated buffer area. In this case splash blocks or downspout protection pads can be used to introduce flow into vegetated buffer areas instead of a level spreader. Drainage areas greater than 300 square feet require construction of the level spreader. Vegetation requirements (below) for the vegetated buffer are the same regardless of use of level spreader or other energy dissipation.

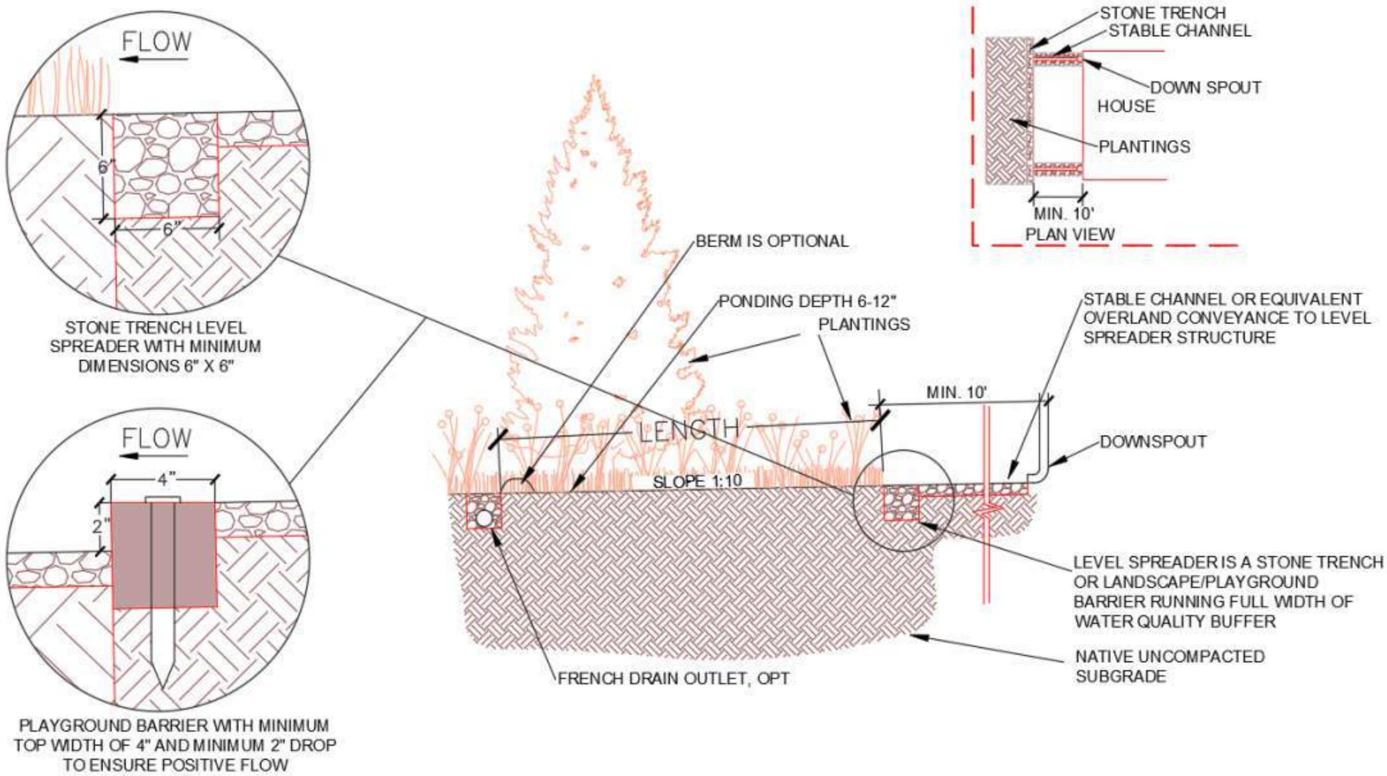
1.3.3 Vegetation

- Vegetation commonly present in vegetated buffers includes turf, trees, shrubs, and other herbaceous vegetation.
- When planting is necessary, choose grasses and other vegetation that will be able to tolerate the stormwater runoff rates and volumes that will pass through the buffer.
- Vegetation used in vegetated buffers should be able to tolerate both wet and dry conditions.

1.4 Maintenance

Clearly mark the buffer extents before construction begins to prevent unnecessary disturbance. After construction, maintain the level spreader and buffer vegetation as needed. Removal of invasive species or diseased plants and planting of new native species is permitted, so long as disturbance from these activities is minimized and the area is replanted.





TYPICAL COMPONENTS

CONSTRUCTION STEPS:

1. Review potential vegetated buffer areas and layout. Vegetated buffer areas should not exceed 8% slope and should direct water away from the home or other structures,
2. Bermed vegetated buffers should <u>not</u> be located uphill from or within 20 feet of a septic field. If there is a concentrated overflow, ensure it is at least 10 feet from building foundations and 20 feet from adjacent property lines.
3. Measure the area draining to the vegetated buffer and determine required surface area and minimum length from the table on the next page. Determine the desired buffer and level spreader options. **All runoff entering the buffer must be sheet flow**.
4. Vegetated buffer should be undisturbed when possible but may be replanted if disturbance is unavoidable.
5. Lay out and mark buffer area to remain undisturbed as well as level spreader location.
6. Construct level spreader by filling trench with appropriate stone and noting overflow points.
7. Construct vegetated buffer option. Install berm if applicable.
8. Construct erosion control at the flow entrance and exit points as applicable.
9. If natural vegetation is sparse in some areas, plant dense vegetation according to plan, or sod/seed. Ensure an irrigation plan is in place if needed.
10. Ensure temporary erosion control is in place as needed until vegetation establishment.

CITY OF GREENVILLE STORMWATER DIVISION	NAME/ADDRESS:	VEGETATED BUFFER SPECIFICATIONS PAGE 1 OF 2

SKETCH LAYOUT

PROVIDE PLAN AND ELEVATION VIEWS OF VEGETATED BUFFER AND HOUSE SHOWING ROOF AREA DIRECTED TO VEGETATED BUFFER AND KEY DIMENSIONS, CONNECTIONS AND OVERFLOW RELATIVE TO PROPERTY LINE. ATTACH ADDITIONAL PAGES IF NECESSARY.

SIZING CALCULATION:

Contributing Drainage Area (square feet)	WQ Buffer Type		
	Disturbed	Undisturbed	Berm
	WQ Buffer Area (sq ft)		
100	200	70	50
500	1000	350	250
1000	2000	670	500
2000	4000	1400	1000
3000	6000	2700	1500
4000	8000	5400	2000
5000	10000	6700	2500

MEASURE CONTRIBUTING DRAINAGE AREA AND READ BUFFER AREA FOR GIVEN BUFFER TYPE. FOR SPECIFIC DRAINAGE AREAS NOT LISTED ON TABLE, INTERPOLATE BETWEEN THE CLOSEST VALUES LISTED.

CONTRIBUTING DRAINAGE AREA= ________ SQ FT
FILTER STRIP AREA= _______ SQ FT
CONVENTIONAL – 25’ MINIMUM LENGTH
BERM OPTION – 15’ MINIMUM LENGTH

MAINTENANCE:

6. INSPECT GUTTERS AND DOWNSPOUTS REMOVING ACCUMULATED LEAVES AND DEBRIS, CLEANING LEAF REMOVAL SYSTEM(S).
7. IF APPLICABLE, INSPECT PRETREATMENT DEVICES FOR SEDIMENT ACCUMULATION. REMOVE ACCUMULATED TRASH AND DEBRIS.
8. WATER AS NEEDED TO PROMOTE PLANT GROWTH AND SURVIVAL ESPECIALLY IN THE FIRST TWO SEASONS.
9. LEAVE UNDISTURBED AS MUCH AS POSSIBLE BUT PROVIDE VEGETATION MAINTENANCE - MOW, PRUNE, AND TRIM AS NEEDED.
10. INSPECT THE WQ BUFFER FOLLOWING RAINFALL EVENTS. FIX EROSION ISSUES IMMEDIATELY.

CITY OF GREENVILLE STORMWATER DIVISION	ATTACH THIS TWO-PAGE SPECIFICATION TO HOUSE PLAN SUBMITTAL	VEGETATED BUFFER SPECIFICATIONS PAGE 2 OF 2

APPENDIX A: INFILTRATION TESTING

When Do I Need to Do Infiltration Testing?

The following LID practices are infiltration-based features which must reliably drain (into the soil or through an underdrain that daylights to a stable outlet) to function as designed:

- LID-01 Dry Well
- LID-03 Modified French Drain
- LID-04 Permeable Pavers
- LID-05 Rain Gardens

The sizing criteria in the individual specifications are based on a required infiltration rate of 0.5 inches per hour. **Many of the native soils in the City of Greenville do not allow for adequate infiltration, therefore a perforated underdrain is required for these infiltration-based LID practices. No infiltration testing is required when using the required perforated underdrain.**

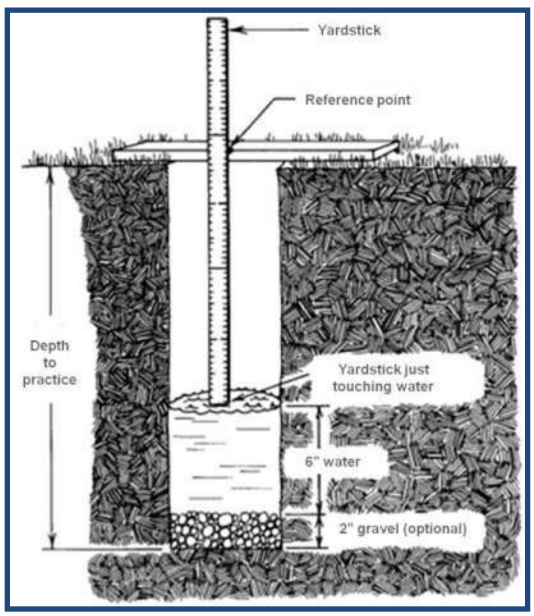
Infiltration testing may be done in either of the following two scenarios:

1. Perforated Underdrain Infeasible: If a functioning perforated underdrain is infeasible due to flat slopes (cannot install an underdrain with positive flow to a stable outlet that daylights) at the location of the infiltration-based LID practice and there are no other possible locations on site, then the following infiltration test may be performed to determine whether an infiltration-based LID practice (listed above) may be installed without a perforated underdrain. The test must return a minimum infiltration rate of 0.5 inches per hour to allow installation without a perforated underdrain. If the test indicates the infiltration rate is less than 0.5 inches per hour and an underdrain is infeasible, then infiltration-based features are not applicable and other LID practices should be used.
2. Verify High Infiltration Rate to Reduce BMP Size: If the site soils have an infiltration rate greater than or equal to 1.0 inch per hour, the size of infiltration-based LID practices (listed above) may be reduced. At the discretion of the property owner, the following infiltration test may be conducted to assess infiltration rate. For every 0.5 inches per hour in excess of the required 0.5 inches per hour, the LID practice size may be reduced by 10% (e.g. an infiltration rate of 1 inch per hour allows a decrease in size by 10%, an infiltration rate of 1.5 inches per hour allows a decrease in size by 20%, etc.) See each individual LID practice specification and detail for the practice-specific size adjustment procedure.

Testing Infiltration: A Simple Approach

When applicable, the following simplified test may be used to determine the infiltration rate of your site's soils.

1. Locate the approximate center of the area where you expect to build your feature.
2. Dig an access pit down to the bottom of the amended soils or gravel layer in the feature.
3. At that elevation dig a narrow test hole at least eight inches deep. You can optionally place 2" of coarse gravel in the bottom. The test hole can be excavated with small excavation equipment or by hand using a spade shovel or post-hole digger.
4. If you run into a hard layer that cannot be penetrated with a shovel or, you come across water in the hole, stop. Infiltration features should not be sited over impenetrable rock surfaces or over high water tables, so your site is inappropriate.
5. Place a flat board across the hole to serve as a measuring point (see figure).



Source: modified from www.ag.ndsu

6. Fill the hole with water to a depth of six inches. Measure from the flat board to the water surface. Record the exact time you stop filling the hole and the height of the water every 10 minutes for fast draining soils for a minimum of one hour or every 30 minutes for slow draining soils for a minimum of two hours.
7. Refill the hole again and repeat step 6 twice more. The third test will give you the best measure of how quickly your soil absorbs water when it is fully saturated.
8. If on the third test the water is dropping at least ½" per hour, the soil will work for infiltration-based LID practices. If the water is dropping at least 1" hour, you may make be able to reduce the size of the infiltration-based LID practice at that location.

Source: https://newsstand.clemson.edu

Source: www.learntogrow.com

APPENDIX B: FILTER MEDIA MIX

Greenville County has developed a filter media mix specification that is utilized for LID-05 Rain Gardens as well as other stormwater practices within the County. For consistency within the Greenville area, the City of Greenville recommends utilizing the Greenville County filter media mix, described below, or latest revision.

What is the recommended filter media mix?

The filter media shall be a uniform mix of sand and organic material meeting the following criteria.

- 80% medium to coarse washed sand
  - Use Masonry Sand
  - River Sand is NOT acceptable
- 20% stable composted material
  - Composted leaf/yard waste and organic/food waste are acceptable
  - Manure-based compost is NOT acceptable
- pH between 5.2 and 8.0 with an optimal range of 6.0 to 7.5
- Minimum infiltration rate of 1 inch per hour with an optimal range of 1 to 6 inches per hour

Receipt from the landscape supplier must be provided before construction of the LID practice to verify compliance with these requirements.

Why was the mix developed?

The filter media mix was developed for the following reasons:

1. Water Quality: To ensure that filter media and LID practices are effective at pollutant removal to improve water quality of stormwater runoff and Greenville County waterbodies.
2. Ease of Implementation: To specify filter media that is composed of locally available materials and can be provided pre-mixed by landscape suppliers without extensive testing.
3. Encourage LID: To streamline the process of acquiring, filter media and encourage the use of for LID practices.

Where is the mix available?

There are landscape suppliers in Greenville County which have confirmed they can pre-mix and provide this filter media to order. A list of potential suppliers is provided below. Contact the landscape suppliers in advance to arrange for timely filter media preparation.

Landscape Supplier	**Website**	**Phone Number**
Upstate Materials	http://upstatematerialsandmulch.com/	864-220-5154
Hensons' Inc. Mulch and More	http://hensonsinc.net/	864-963-9330